EBRUARY
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Fertilizer from Sewage

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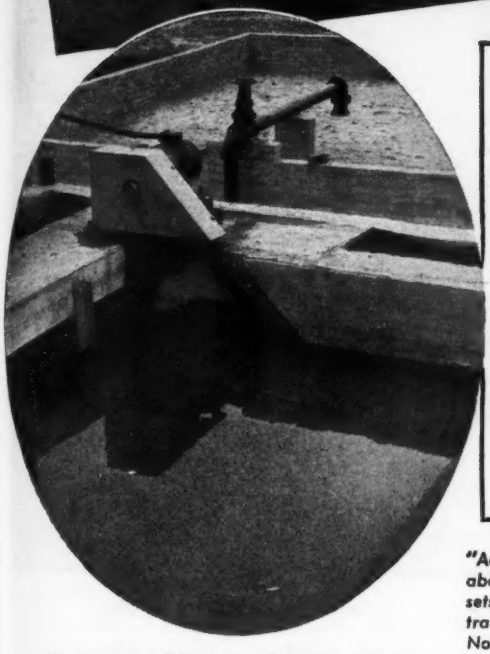
There are no flies, no odors at this plant, and the all-concrete tank construction means there will be no scraping or painting of steel tanks and baffles to prevent rust and collapse. Nor is a waste sludge hopper required.

Bulletin 6650 gives a complete description of the "Aerifier." Send the coupon for complete information.

Consulting engineers retained by owner for sewerage facilities and sewage treatment plant—Smith and Gillespie, Jacksonville, Florida. Contractor—Paul Smith Construction Company, Tallahassee, Florida.



Yeomans new "Streamline" Sludge collector for rectangular settling tanks is in operation at Gulf Shores. This unit is 20 feet long by 8 feet wide with 7 foot side water depth and is functioning in the primary settling tank.

AN ALL-YEOMANS PLANT

AERIFIER—No. 50 "SPIRAL-FLO" AERATOR—combines aeration and final settling in one concrete tank.

SLUDGE COLLECTOR—new Yeomans "Streamline" design; 20 ft. long, 8 ft. wide, 7 ft. water depth.

SLUDGE PUMP—YEOMANS No. B1100—40 g.p.m. to 15 ft. T. D. H.

SEWAGE PUMPS AT LIFT STATION—two Yeomans No. 4M3, 100 g.p.m. to 48 ft. T. D. H.

"Aerifier" in operation is viewed from above. The "Spiralflo" aeration cone sets up a spiral movement that penetrates throughout the entire tank. Note the loading funnel which loads the mixed liquor for transfer to the corner settling compartments. The latter can be seen in the lower left and right corners and their quiescent condition assures thorough settling.

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Entered as second-class matter at the Post Office of New York, N. Y., Sept. 1, 1929, under the Act of March 3, 1879.
Published monthly by PUBLIC WORKS JOURNAL CORPORATION, 310 East 45th St., New York 17, N. Y.
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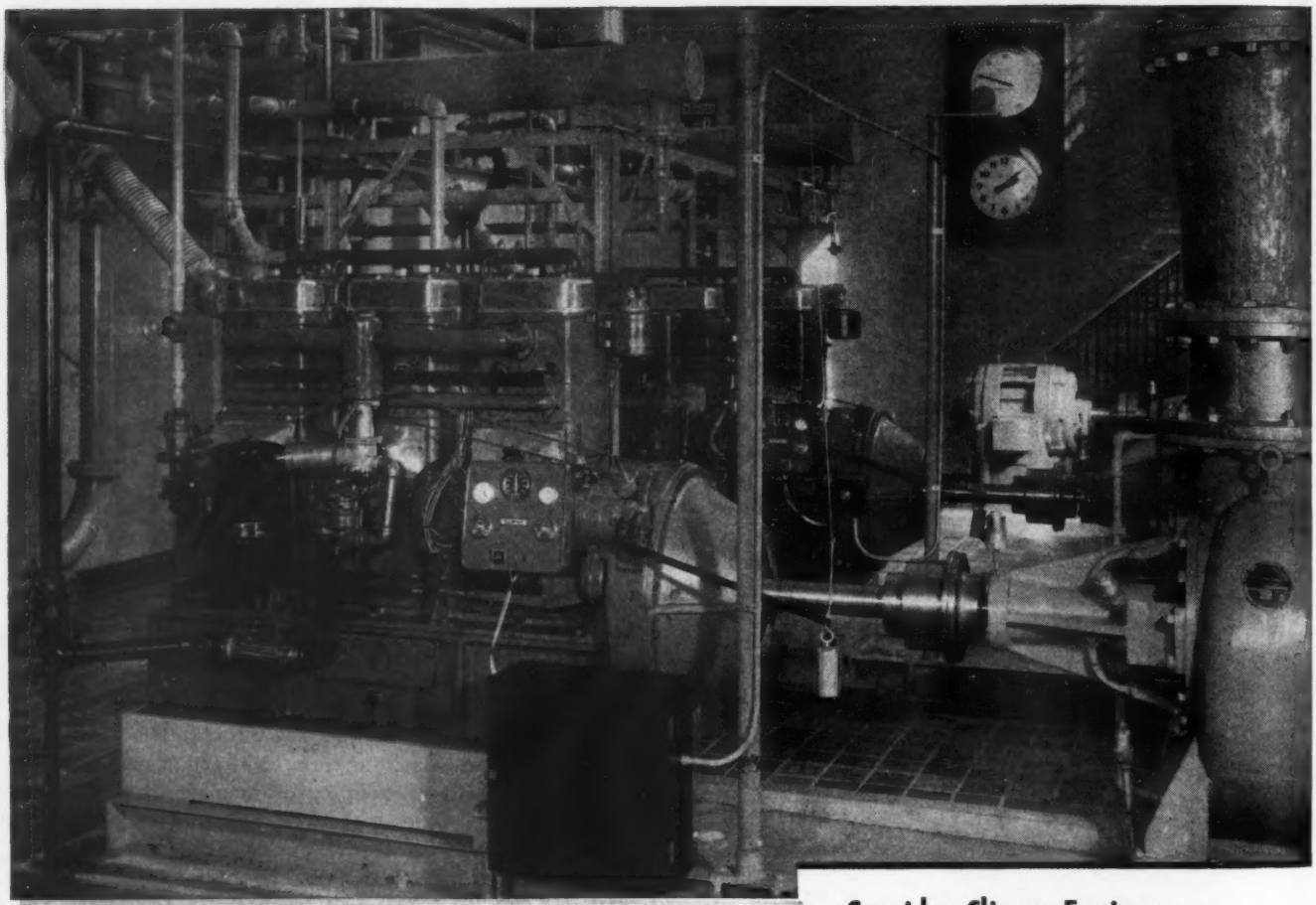

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Consider Climax Engines before approving a new installation. There are 4, 6, 8, and 12 cylinder, 4-cycle types that operate economically on gasoline, butane, sewage or natural gas. For complete information and specification bulletins, write Climax Engineering Company, Clinton, Iowa.

*Climax Engines, operating smoothly and efficiently on sewage gas, generate power for the equivalent of ¼ cent or less per kilowatt hour. For a plant serving a population of 20,000 or more, this ¼ cent cost rate would include *all costs* —maintenance, lubricating oil, interest on investment and depreciation. In addition to this saving, 50% heat recovery from jacket water and exhaust may be used to heat digester tanks and buildings.

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Vol. 77 No. 2

W. A. HARDENBERGH and A. PRESCOTT FOLWELL
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Published monthly by PUBLIC WORKS JOURNAL CORPORATION

Editorial and advertising offices: 310 East 45th St., New York 17, N. Y.

J. T. MORRIS, *President;* W. A. HARDENBERGH, *Vice-President;* CROXTON MORRIS, *Treasurer;* A. PRESCOTT FOLWELL, *Secretary. Advertising representatives:* New York: ARTHUR K. AKERS, *Advertising Manager;* Chicago: LEWIS C. MORRIS, 612 No. Michigan Ave., Chicago 11, Ill. SUBSCRIPTION RATES: U.S.A. and Possessions, Mexico and Cuba, $3.00; Canada, $3.50. All other countries, $4.00. Single Copies, 35 cents each except issues containing book-length texts, which are $1.00 apiece.

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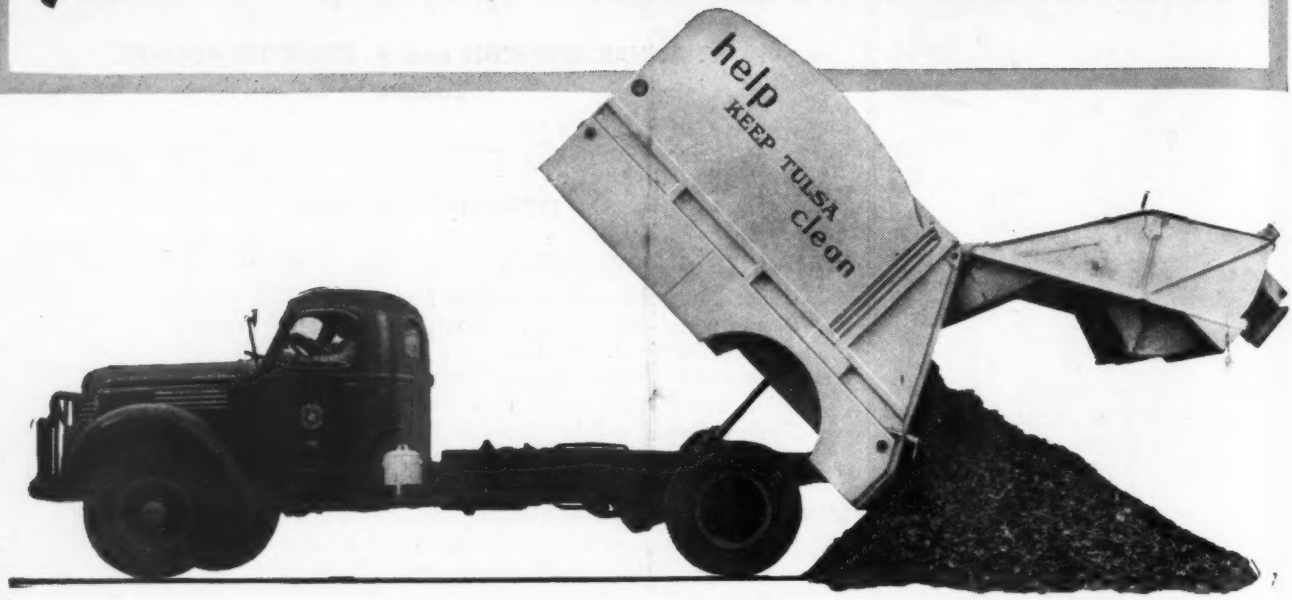

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The FOURTH Everdur Well Screen installed for the City of Elkhart...

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Two more wells subsequently installed by Layne-Northern were therefore equipped with Everdur. The snapshot above shows the latest installation, with an Everdur well screen ready to be lowered into position. Standing by are Mr. Richard B. Corns (left), Waterworks Superintendent, and his assistant, Mr. Swartz.

The performance of these Everdur well screens is typical of the service rendered by sewage treatment and waterworks equipment made of this tough, corrosion-resistant alloy... installations of which are still in service after 18 years. For detailed information, write for Publications E-11 and E-6. 46209

*Reg. U. S. Pat. Off.

38" diameter well screen fabricated of Everdur 1010 sheet, .203" thickness and welded with Everdur rod. Fourth installation made for the City of Elkhart, by Layne-Northern Company, Mishawaka, Ind., affiliate of Layne & Bowler, Inc., Memphis, Tenn.

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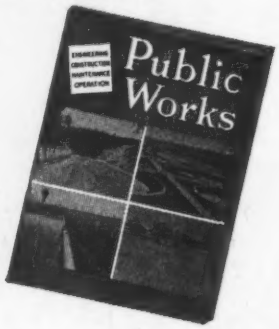
6—Sedimentation Tanks
7—Activated Sludge
8—Imhoff Tanks
9—Trickling Filter Operation
10—Contact Beds and Sand Filters
11—Chemical Treatment
12—Disinfection of Sewage
13—Sludge Digestion Tanks
15—Maintenance of Equipment
16—Other Factors.

This appeared as a book-length section in PUBLIC WORKS Magazine — over 18,000 words and many illustrations. Copies of this issue $1.00 per copy.



THE OPERATION OF WATER TREATMENT PLANTS

While "The Operation of Water Treatment Plants" was written especially to assist superintendents and operators to pass State Licensing Tests, it is a great help to every water works man. Here is one place you have the basic information covering all phases of plant operation. Even those with no previous technical school education will find it easy to learn from this valuable text.

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Copies of PUBLIC WORKS containing this article are $1.00 a copy postpaid.

Water and Sewage Chemistry and Chemicals

This comprehensive article was published complete in the June 1944 issue of PUBLIC WORKS.

Contents include:

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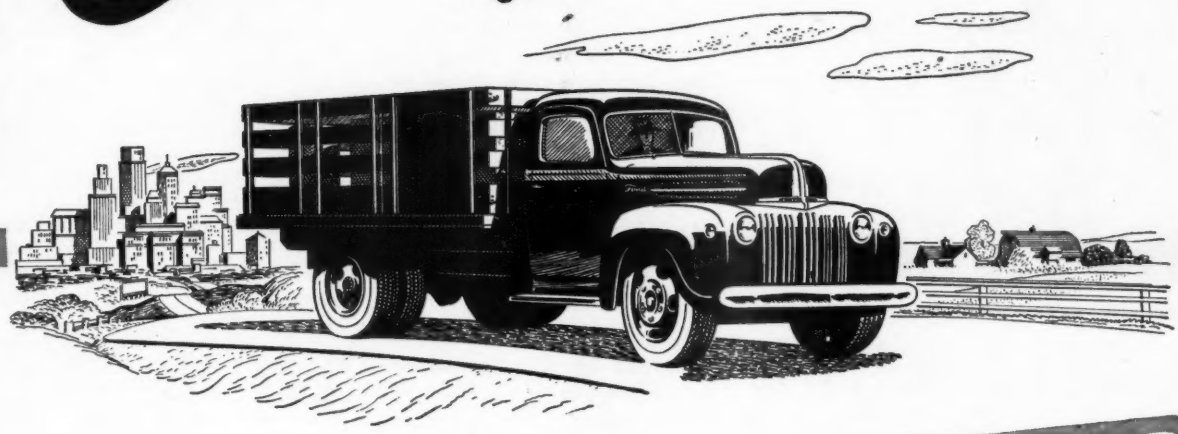

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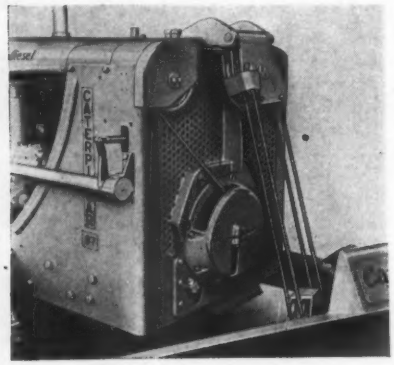
PUBLIC WORKS Equipment News

New "Caterpillar" Cable Control Unit

Production of a new single drum, front-mounted cable control unit with a multiple disk type clutch has been announced by Caterpillar Tractor Co., Peoria, Illinois. FPM. line speed, bare drum, is 357 for the D8, 375 for the D7, and 525 for the D6. FPM. line speed, full drum, is 527 for the D8, 552 for the D7, and 780 for the D6. Drum diameter for all three models is nine inches, length 2½ inches, and drum flange diameter 14 inches. The cable size is ½-inch. Drum capacity is 75 feet and the clutch has 12 friction surfaces with an area of 564 square inches.



Caterpillar Cable Control Unit

Homelite Announces New Lightweight Generators

Production of two new gasoline engine-driven generators is announced by the Homelite Corporation, Port Chester, New York. Designed as a portable power source for electric tools, floodlights, radio, amplifying or motion picture equipment, these units can be moved quickly to any location or job. They are ideal for emergency power or when power lines are inaccessible. Extremely portable, the Model 21D, a 2000-watt, 120-volt D.C. generator, weighs only 115 pounds. Both units have over-all dimensions of 22⅜ x 17⅛ x 21⅛ inches.

Incorporating new design features developed for the Army and Navy and tested under actual combat conditions, these units are sturdy and dependable. The use of aluminum alloys for all large castings has permitted an increase in output without sacrificing portability. The single-cylinder air-cooled two-cycle engine has only one valve, a rotary disc type, which is self-seating and requires no adjustment.

An improved Wico magneto gives a strong spark for easy starting. The engine speed is controlled by an automatic built-in governor. A pressure-vapor oil system sprays a film of fresh oil over all moving parts with each revolution. The generator is direct-connected to the engine, with the armature mounted on the engine crankshaft.

Balcrank Portable High Pressure Lubricator

The portable Balcrank "Minit" high-pressure lubricator insures complete and correct lubrication for all construction equipment. A study by the manufacturer of on-the-job lubrication practices showed that oils and greases available are excellent, and machines for the most part are also excellent, but lubrication is not adequate. It was to meet this problem that the "Minit" lubricator was designed. A special adapter permits a change in seconds for button-head, hydraulic or pin-type fittings. Full information from Balcrank, Inc., Cincinnati, Ohio.

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The precise location and depth of buried pipe and cable is possible with this device which adds finding ability to the location of shorts, crosses, grounds, and wet spots. It tells just where cable or pipe is buried; it finds old cable or pipe even though laid many years ago; it locates the exact path of cable or pipe to or from buildings; and finds the position of a water main in a street or alley; it is especially valuable for checking depths at river crossings and in determining whether or not a service pipe is below the frost line. Address W. C. Dillon & Co., Inc., 5410 W. Harrison St., Chicago 44, Ill.

Hetherington & Berner Moto-Paver

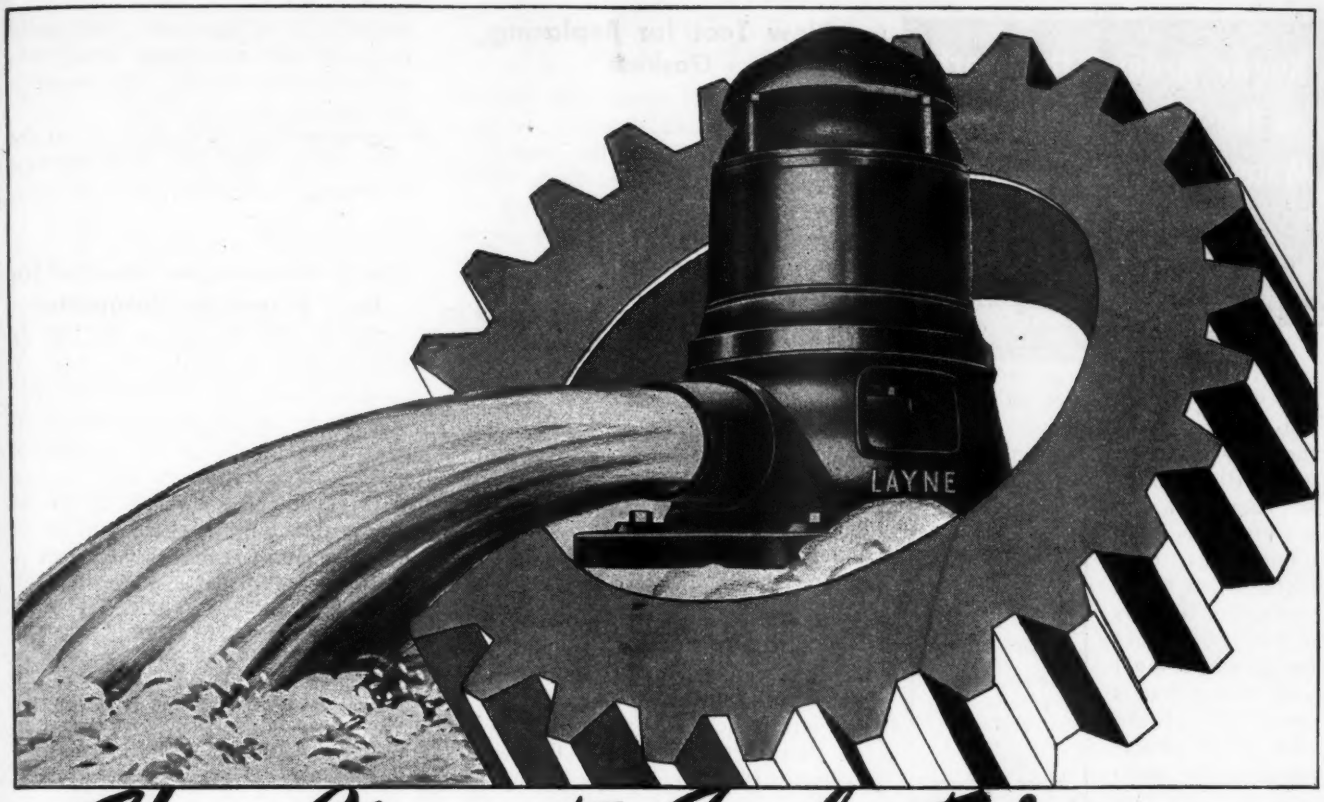
Hetherington & Berner, Inc., of Indianapolis, have announced the Moto-paver, a new asphalt travel plant. This is a completely self-contained, continuous mix machine, 8 feet wide and 22 feet long, mounted on pneumatic tires and driven by two gasoline engines. One engine is for driving the mixer and related units, the other for moving the machine along the road, thus the plant can travel at any desired paving speed without varying the mixer speed.

Capacity of the plant is 100 to 120 tons per hour of any low cost or medium type bituminous mix. Paving speed can be regulated between 4 and 50 feet per minute. The machine will travel under its own power 15 to 18 miles per hour, so no trailer is necessary to haul it from one job to another.

The plant has a novel spreading and laying device which eliminates the necessity for a separate paving machine and makes it possible to use the machine for various widths of roads and almost any conditions of crown and thickness. Operation requires two or three men, depending upon the particular job. The mixer and asphalt pump are jacketed, and provision is made for the heating of both of these units, as well as the bitumen tanks.

The Moto-paver may be used either as a traveling plant, with the aggregate dumped directly from trucks into the plant on the road; or, with the special loader unit, windrowed material can be picked up off the road. The machine will use any available local material. Ask for Bulletin MP-46 which gives a complete description and specifications. Address Hetherington & Berner, Inc., 729 Kentucky Avenue, Indianapolis 7, Indiana.

Hetherington & Berner Moto-paver.



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Flange-Jacks operate with a minimum of labor. They exert tremendous pressures smoothly and evenly—eliminating vibration along the pipeline and the possibility of causing new leaks in nearby joints. Flange-Jacks are capable of opening joints against a load of 15 tons—without damage to the flanges.

These tools are simple in design; jaws are heavy, one piece steel forgings; screw points are case hardened. Standard size Flange-Jacks open all 2″ to 20″ flanges and hold them in perfect alignment.

Flange-Jacks are a product of T. G. Persson Company, 224 Glenwood Avenue, Bloomfield, New Jersey.

Bucyrus-Erie Announces New 1½-Yd. Excavator

A new 1½ yd. model 38-B fully convertible excavator is announced by Bucyrus-Erie Company. Showing a remarkably fast operating cycle in months of thorough field testing, the new unit has demonstrated continuous record-breaking output for users.

Fundamentally constructed for equal effectiveness as a shovel, dragline crane or clamshell, the new 38-B offers a number of operating refinements. As a dragline, the 38-B has big working ranges with a new mast-type suspension available for long booms. Full rotating fairlead, selection of wide, long and tapered end crawler mountings for ample bearing area and superior performance in soft going are other dragline features.

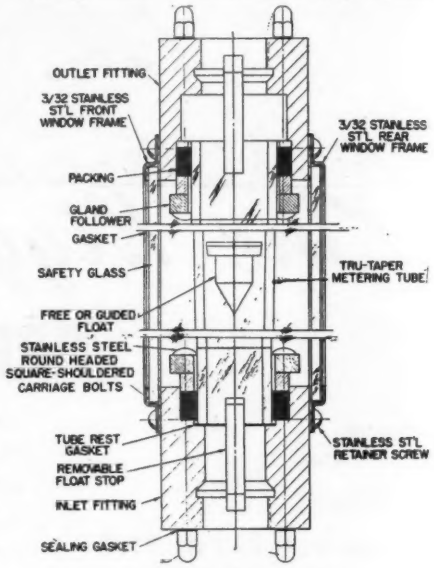
Features of the new 38-B shovel include a strong but light boom with large diameter point sheaves for effective application of digging force, independent positive twin rope crowd and high lip all-welded dipper for fast filling and dumping in rock or dirt.

As a crane, the 38-B offers long booms with optional jib extensions two-clutch operated independent boom hoist with full, accurate power control of raising and lowering, and optional independent two speed propel. Ample capacity, easy control of clutches, drum capacities and dimensions, balance of speed and power, accessibility of machinery, and easily mounted and demounted front ends make the new 38-B a truly convertible excavator.

For additional information on the new 38-B, write to Bucyrus-Erie Company, South Milwaukee, Wisconsin.

Many Advantages Claimed for New Flow-Rate Rotameter

The Brooks Rotameter Co., P. O. Box B-1244, Lansdale, Pa., has announced their new "Full-View" Rotameter for accurate flow-rate measurements and control. It is provided with safety shielding, and is specially designed to stand up to the rough and tough services and under the corrosive conditions met with in the process industries. Safety shielding is obtained by ¼″ thick glass windows held in place by 3/32″ stainless-steel window frames in front and back.



Details of Rotameter.

It is provided with an interchangeable "Tru-taper" precision metering tube, and has so wide a space between the side plates that the position of the float can be read easily and accurately even from a position at an angle to the normal. The casing is so designed that the precision metering tube itself can be replaced while the instrument is still in the line of flow. All external parts of the meter are treated to prevent corrosion where they are not made from corrosion resisting material.

The "Full-view" Roto-Meter is supplied in sizes from ⅛″ to 4″, and can be obtained as a simple flow-rate indicator, or as a remote recording instrument, or with attachments for recording and controlling the rate of flow.

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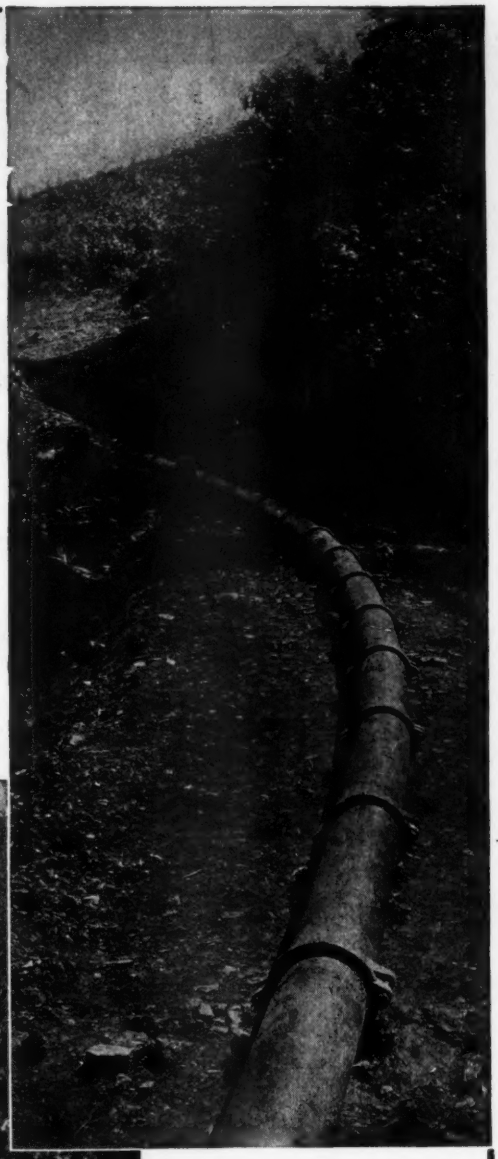

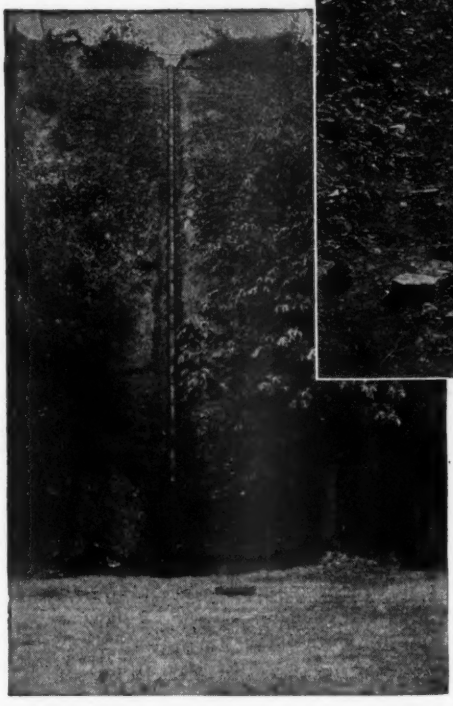

Above *All straight lengths of Universal pipe in this curve.*

At left *16" pipe laid on a 45-degree slope. Note deflection at top to level ground without fittings.*

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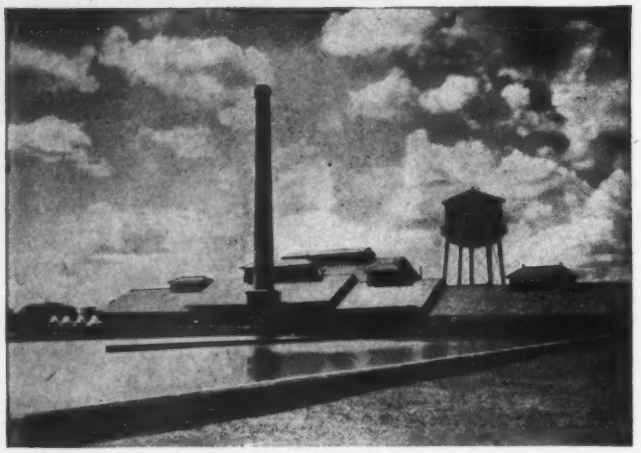

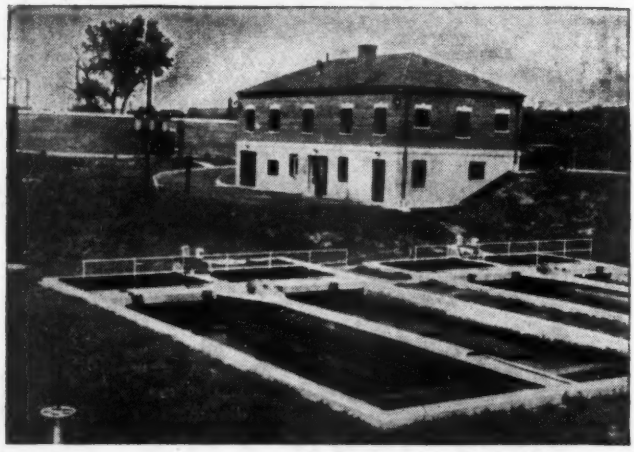

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2. Gives better floc formation resulting in longer filter runs.
3. It is a low-cost coagulant.
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6. High in quality, its constant uniformity can be counted upon.
7. Aids in the reduction of tastes and odors.

★ FOR SEWAGE PLANTS

1. Clean, easy to handle, dry feeds well, and economical to use.
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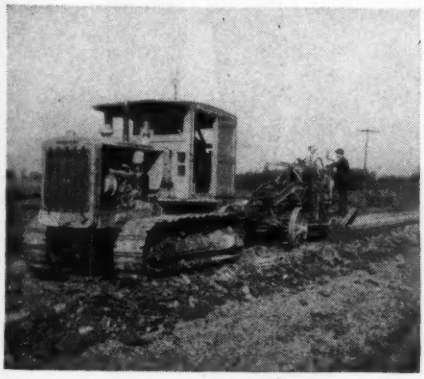

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2. Applying Tarvia to Pulverized Soil.

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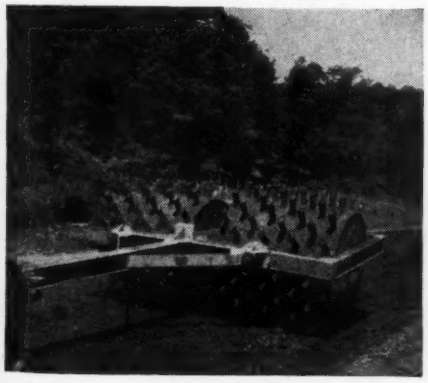

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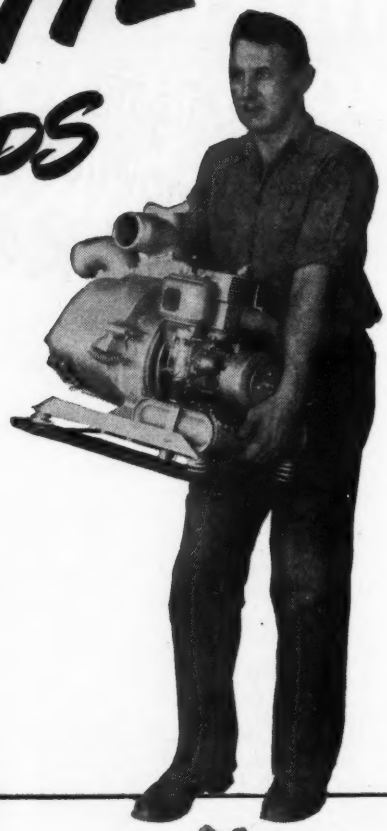
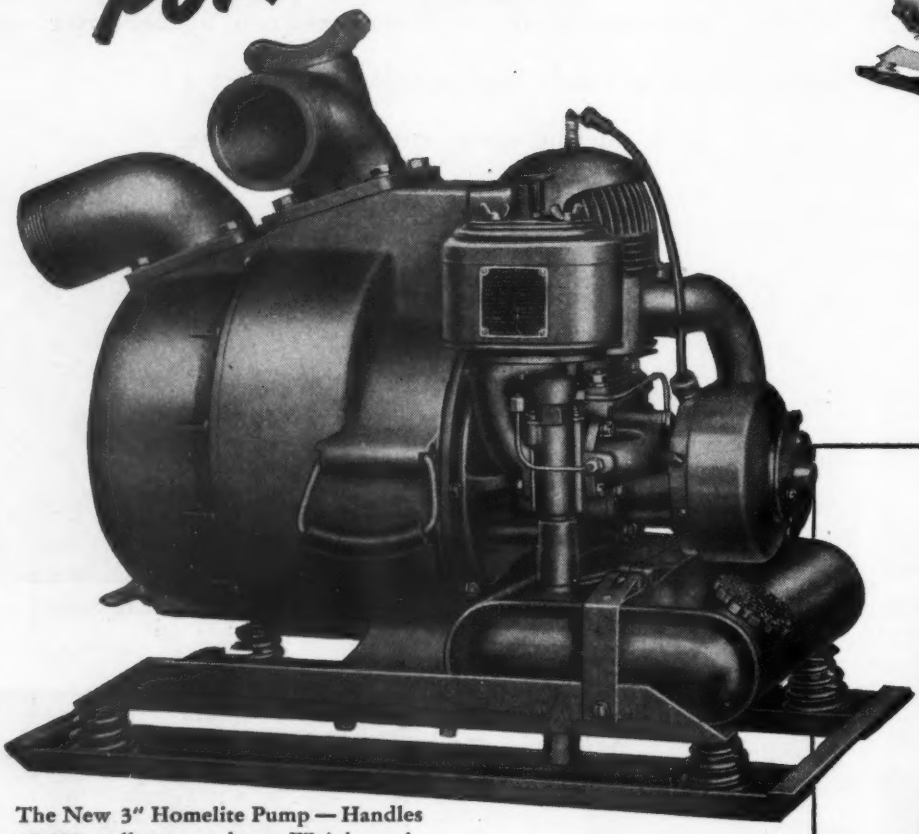
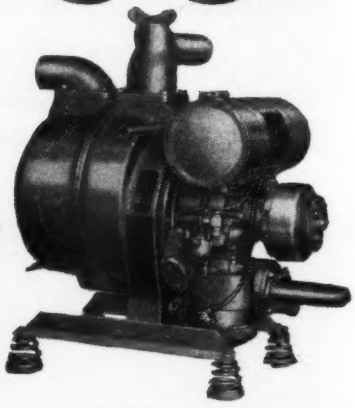
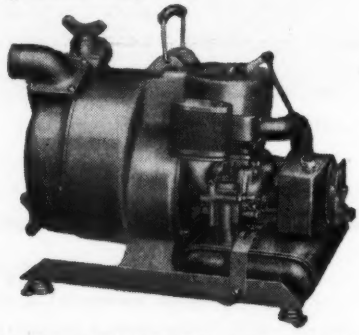




The New 3" Homelite Pump — Handles 15,000 gallons per hour. Weighs only 95 pounds complete.



The new 2" Homelite Pump — Handles 10,000 gallons per hour. Weighs only 88 pounds complete.



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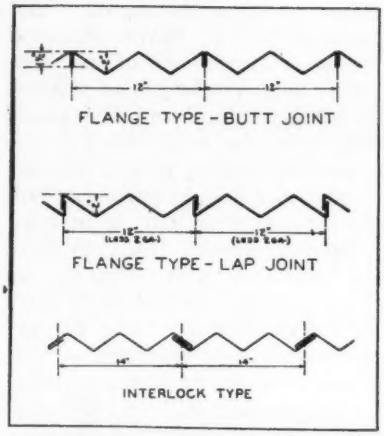


Fig. 1. Some types of steel sheeting.

Advantages of Steel Sheeting for Use in Trench Excavation

By W. T. ADAMS

Specification Engr., Armco Drainage & Metal Products, Inc. and Associated Companies

When we were preparing the article on Army safety requirements for excavations, which was published in the January issue, we sent a copy of the data to Mr. Adams and asked him to present the case for steel sheeting. We did this because we believe very strongly in safe practices in construction and we feel that, in this respect at least, steel sheeting is far superior to wood. Mr. Adams brings out other advantages of steel sheeting as well.

THE Army and various other specifying groups, and local regulations as well, have set up certain minimum safety requirements for sheeting trenches (See Public Works, January, 1946). These requirements are generally based on the use of wood planks. The use of steel sheeting greatly increases the safety of the workmen, not only by adding strength but also because of the greater ability of steel to withstand flexure without rupturing.

In addition to greater safety, there are many economies to be gained by the use of a light-weight steel sheeting such as the one shown in Fig. 1. It can be pulled and reused many times; on several jobs, such flange type sheeting has been salvaged and reused over one hundred times. Steel sheeting permits wider spacing of the waling with larger safety factors than wood sheeting, and gives more working room in the trench and therefore more efficiency in excavating, lining, laying and jointing the pipe line.

Steel sheeting is easier to drive than wood. Where the excavating is done as the sheeting is driven to prevent caving of the sides of the trench, steel sheeting can be driven with a maul or light pneumatic hammer. Because of the extra strength of the steel and its low resistance to driving, it can often be driven to full penetration before any excavating is done. This is particularly effective on new construction where the underground conditions are known; here the gain in economy is large. Not only can excavation proceed without delay due to work on the sheeting, but the workmen in the trench feel much safer and more secure and respond by turning out more work.

The weight of light gage steel sheeting is approximately the same as wood, and for equal strength is actually less. It nests together, requires less storage space and is easily trucked and handled.

Fig. 2 shows an installation of flange type steel sheeting in a sewer trench in a mid-western city. It was driven before excavating to a penetration of 14 ft. through a stiff clay and glacial till formation. There were two small water bearing layers above the grade

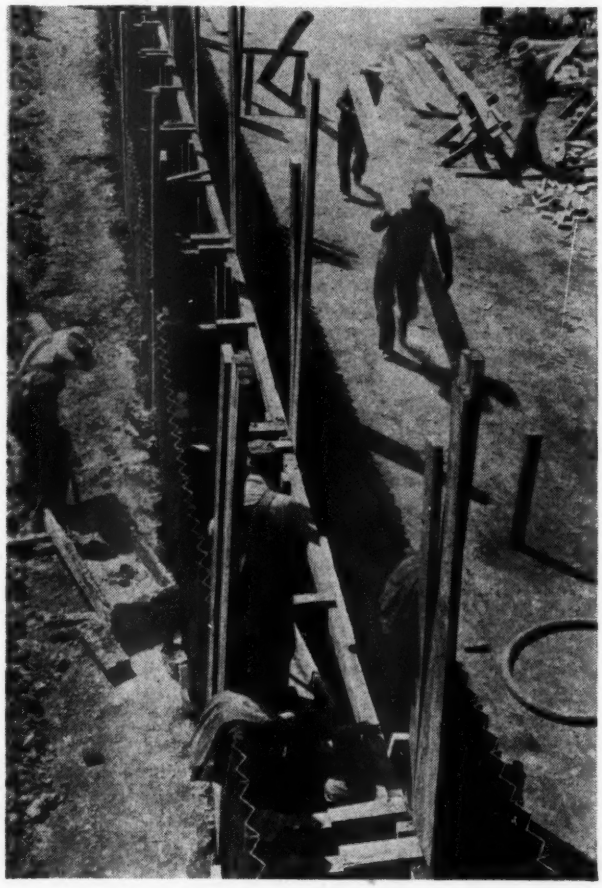
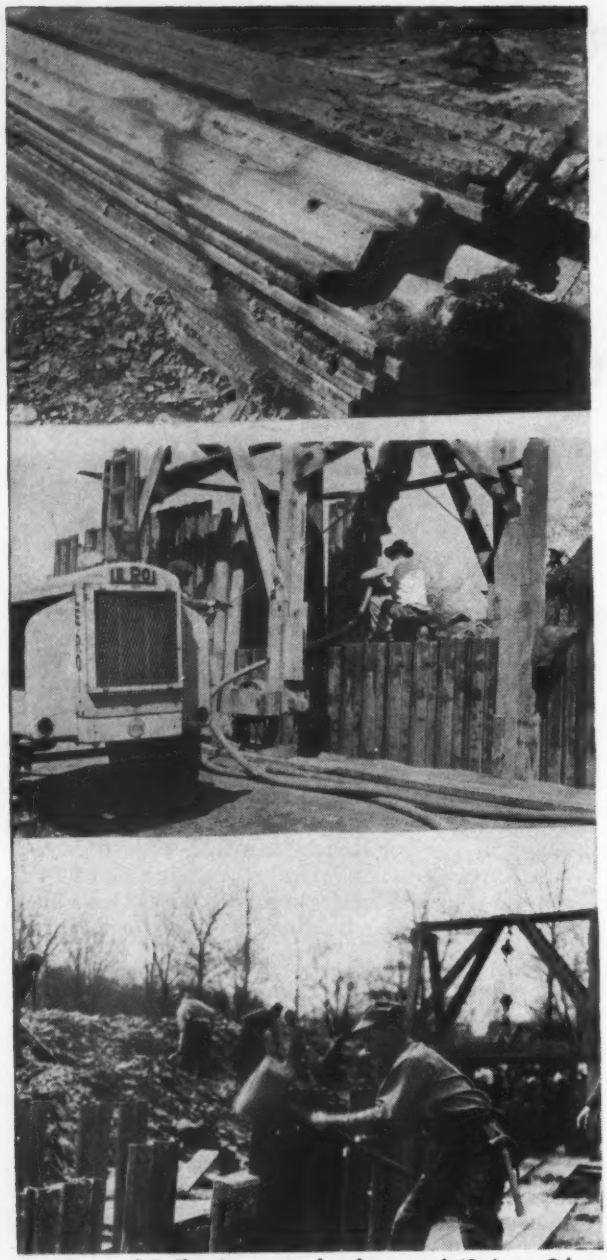


Fig. 2. Steel sheeting used for sewer trench.



Figs. 3, 4 and 5. Sheeting at top has been used 40 times. Other photos show methods of driving.

line but the sheeting proved sufficiently watertight to prevent interference from infiltration without any special treatment. At the right two men are shown carrying an 18-ft. length of steel sheeting.

The sheeting shown in Fig. 3 had been used over forty times when the photograph was taken. The holes shown in the sheeting are for pulling hooks which are frequently advantageous in pulling sheeting from deep trenches. The sheeting can be pulled with hand winches or in exceptional cases by reversing the pneumatic driving tool.

Fig. 4 shows a Vulcan hammer and driving rig which was set up to drive steel sheeting before excavating on a fairly long sewer trench.

Fig. 5 shows steel sheeting being driven by hand. The steel driving head shown is recommended and generally used to protect the sheeting in driving.

Corner sections are available for abrupt changes of direction but these are not needed when using the flange type of sheeting, which can be used for any change in direction up to 90°.

Pulling of the steel sheeting can be delayed until the backfilling is well advanced as shown in Fig. 6, thereby avoiding damage to the surface which might be caused by cave-ins.

The spacing of the wales and struts required for any particular trench job is limited by local regulations and governed by the ground conditions. It is impossible to make any general statement covering spacing; however, the manufacturer's catalogs give spacing recommendations for various soil pressures, and manufacturers' representatives will advise on local conditions and recommend best methods of use. The kind of pipe that is being laid, the length of sections and the diameter, as well as the kind and dimensions of waling material and strutting available, will determine which is the most economical design for any particular site. How much sheeting is necessary will depend upon the rate of progress that is planned for the job. Steel sheeting adapts itself to both large and small jobs. The ease with which it can be stored, handled, driven, pulled and salvaged make it valuable equipment for maintenance units to have on hand. A thousand lineal feet of sheeting, or perhaps even less, of a length to fit the depth requirements of the particular community will pay for itself many times over and will generally increase markedly the speed and safety of trench work.

Minnesota Water Pollution To Be Controlled By Commission

Minnesota has established a Water Pollution Control Commission with Chester S. Wilson, Commissioner of Conservation, as chairman, and Samuel P. Kingston, of the Department of Health, as consultant. The Commission has been given the power to establish pollution standards, and to regulate the discharge of sewage and industrial wastes into the streams of the State.

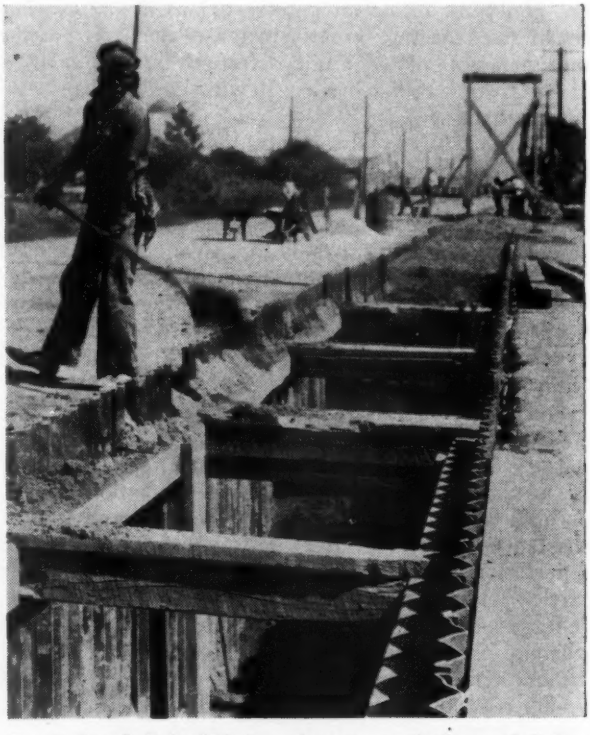


Fig. 6. Trench is backfilled to the top, see background, before pulling sheeting to prevent damage by caving.

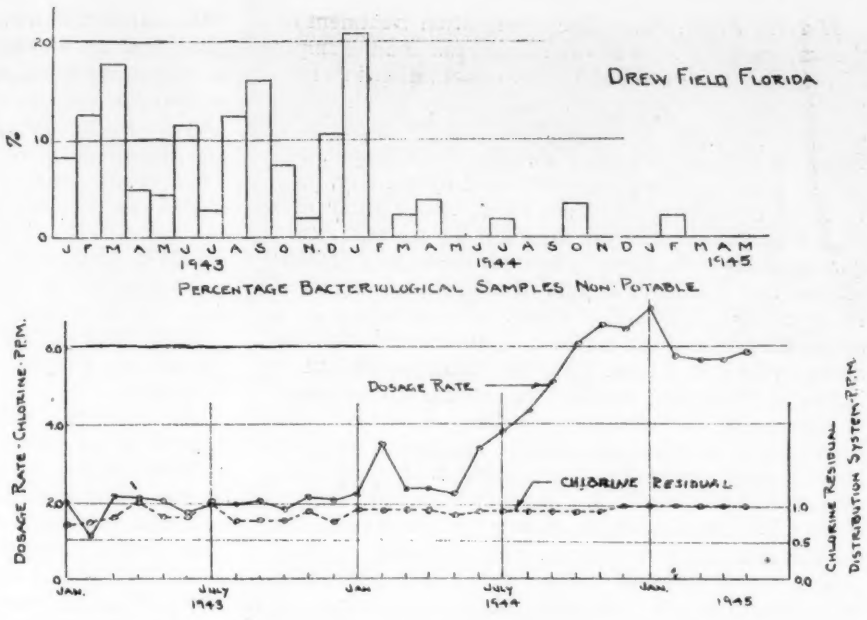


Fig. 1. Improvement in quality of water at Drew Field following increase in chlorine dosage rate.

Breakpoint Chlorination of Military Water Supplies in the Fourth Service Command

Experiences at five Army stations in the Southeastern states are summarized and bacteriological results given.

IT has been the general policy of the Fourth Service Command, which comprises the seven Southeastern states, to consider the process of chlorination of water supplies primarily as a precautionary measure for the protection of the bacterial quality of the water from the source to the consumer. This concept of chlorination, in most instances, when coupled with strict requirements regarding control of the source, treatment, and distribution, has proved satisfactory for the production of water of acceptable bacteriological quality.

At several installations, however, it has been necessary to expand the function of chlorination beyond this elementary concept because of one or more of the following factors: *a.* To improve the efficiency of other treatment processes such as coagulation; *b.* To utilize sources of supply of unsatisfactory bacteriological quality; *c,* To improve the esthetic qualities of ground water supplies such as taste, odor, and color, where chlorination is the only treatment provided.

If the so-called "breakpoint" chlorination treatment can be defined as the addition of chlorine to water at a dosage rate which satisfies the chlorine demand of the water, completely oxidizes the ammonia content, and permits the maintenance of a free chlorine residual, then breakpoint chlorination is employed at a majority of the supplies of this Command. The criteria for the maintenance of a 0.4 ppm chlorine residual in active parts of the distribution system has automatically necessitated the breakpoint treatment, since most of the supplies have a low ammonia content. Records of a representative group of supplies operated on this basis during the past several years, are as follows:

Moody Field, Ga.—The Moody Field water supply is an example of breakpoint chlorine treatment made necessary by the 0.4 ppm requirement. This supply is obtained from two artesian wells approximately 400 feet in depth. Chemical analysis is as follows:

Total Solids	171 ppm
Alkalinity	53
Hardness	99
Iron as Fe	0
Chlorine Demand	7 ppm

From the wells, water is discharged into a 500,000 gallon ground storage reservoir, and is repumped into the distribution system. Attempts to maintain a 0.4 ppm chlorine residual by applying a chlorine dosage of 1 to 2 ppm to the booster pump suction, resulted in undesirable tastes and odors and entirely unsatisfactory bacteriological results. Chlorine application was made at a point ahead of the reservoir and the dosage increased to 9 to 10 ppm. After approximately 20 hours contact, a minimum free chlorine residual of 0.4 ppm is maintained in the distribution system and bacteriological results have been excellent. Average non-potables for 1943 were 1.5% and for 1944 0.7%.

Drew Field, Fla.—Another example of breakpoint treatment made necessary by the 0.4 ppm chlorine residual criteria is the Drew Field, Fla., water supply. This supply is obtained from 6 artesian wells approximately 200 to 500 feet in depth. The wells discharge into force-draft aerators and then into ground storage reservoirs. While aeration reduces the chlorine demand to 1 to 2 ppm, it was found impossible to maintain a chlorine residual or produce a water of satisfactory bacteriological characteristics by applying chlorine to the booster pump suctions. Consequently in the spring of 1944, application of chlorine was changed to a point ahead of the storage reservoirs, and the dosage gradually increased to 5.0 ppm. The improvement in the supply is shown in Fig. 1.

MacDill Field, Fla.—The chlorination treatment of the water supply at MacDill Field, Fla., is an example of the application of breakpoint chlorination in order that a source of supply of unsatisfactory bacteriological quality might be utilized. This supply is obtained from the City of Tampa, Fla., municipal supply. Although chloramination was employed by the city, poor treatment, excessive filtration rates, and a dirty distribution system resulted in water of unsatisfactory quality at the post. Investigation of the supply demonstrated that a 0.3 to 0.5 ppm of ammonia dosage was being added at the city plant. This resulted in a chloramine residual at the field when the rechlorination dosage was 1 to 2 ppm. Chlorine dosages sufficient to induce a breakpoint resulted in extremely unpleasant tri-chloramine taste and odor problems on the post. Also capacities of installed chlorination equipment were not large enough to permit these dosages. Through improvements effected in the municipal treatment plant during 1943, the ammonia dosage was decreased, and the chlorine dosage increased. This permitted application of breakpoint chlorination at the field with existing equipment and resulted in maintenance of a free chlorine residual and satisfactory bacteriological results. The resulting improvement is shown in Fig. 2.

Camp Wheeler, Ga.—The application of breakpoint chlorination proved to be both unsatisfactory and unnecessary for the Camp Wheeler water supply. The Camp Wheeler supply is obtained from the Macon, Ga., municipal supply. Chloramination is employed at the city plant and water is of satisfactory bacteriological quality. Rechlorination is employed at the Post. Application of chlorine dosages in excess of 1 ppm resulted in a breakpoint reaction. As no contact period is provided, this treatment resulted in a particularly bad taste and odor problem. The chlorine dosage was therefore reduced to 0.5 to 0.7 ppm, resulting in maintenance of a chloramine residual. Bacteriological results have been satisfactory. During the 29 months ending May 1945, there was no non-potable sample.

Fort Jackson, S. C.—This is an example of the usage of chlorination for the improvement in treatment efficiencies of a surface supply. Prechlorination has been continuously employed at an average dosage rate of 5 ppm. During the period Aug. 1941 to July 1942 chloramination of the finished water was employed at an average ratio of NH_3/Cl_2 of ¼. Following that period, a free chlorine residual was maintained. For experimentation, preammoniation was employed during the period Dec. 1943 to May 1944, at a dosage ratio of NH_3/Cl_2 of approximately 1/15. This resulted in an induced breakpoint reaction. After May 1944, pre- and post-chlorination alone was again employed and a free chlorine residual maintained. Bacteriological results have been uniformly good.

In addition to the above listed examples, chlorination has been used to decrease the iron content of ground waters in Mississippi, and the hydrogen sulfide content of ground waters in Georgia, Florida and Alabama.

As mentioned before the criteria for the maintenance of a 0.4 ppm chlorine residual has been mainly responsible for application of breakpoint chlorination in this service command. However, this has often been a drastic treatment and has often resulted in unpalatable water. Experience has indicated that the process cannot always be applied by the simple expedient of increasing the chlorine dosage, but that such factors as point of application, length of contact, and relationship with other treatments such as pH control, must be taken into consideration. Breakpoint chlorination, like other chemical treatment processes must impose certain design factors upon water treatment plants in order to produce, in all instances, a water that is desirable from both the esthetic and bacteriological viewpoints.

Levels in Water Tanks Automatically Controlled

A city with a population of 54,000 having a water consumption of 3,650,000 gpd, Kalamazoo, Mich., is topographically divided into a low-pressure area of 5.5 sq. mi. and a hilly high-pressure area of 3 square miles. Water pumped from wells driven to an underlying aquifer supplies the lower-lying sections of the city, and also feeds booster pumps of 4,200 gpm capacity which raise the pressure to supply two elevated tanks for the high-pressure area. The booster pumps are automatically started and stopped, over a single pair of wires leased from the telephone company, from a water level controller placed in the larger and higher tank. The overflows of both tanks are located at the same elevation above city datum, the water level in the smaller tank (350,000 gal.) following that in the larger tank (700,000 gal.). In the event of a heavy draft during a large fire, the possibility of overflow in the smaller tank is avoided by an altitude valve. Both tanks were fabricated by the Chicago Bridge and Iron Works.

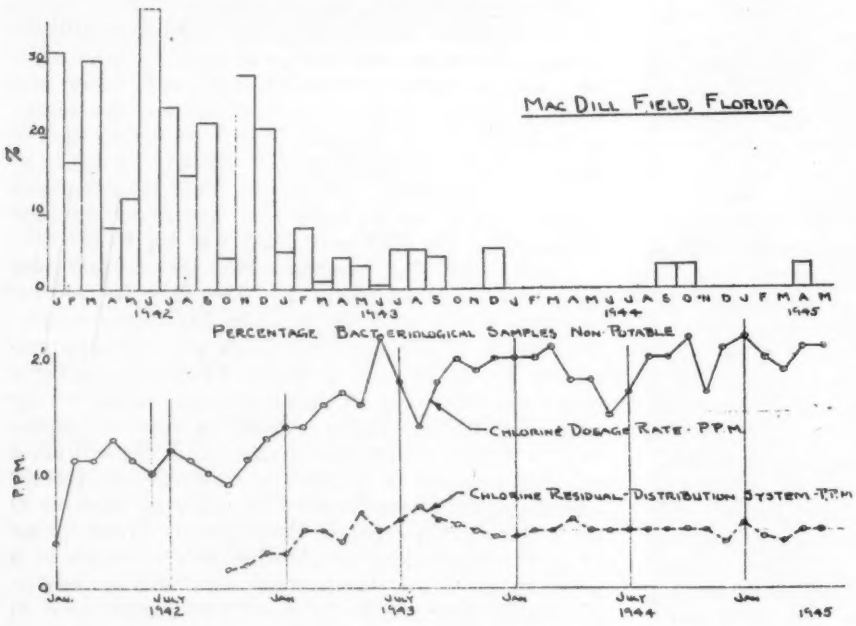
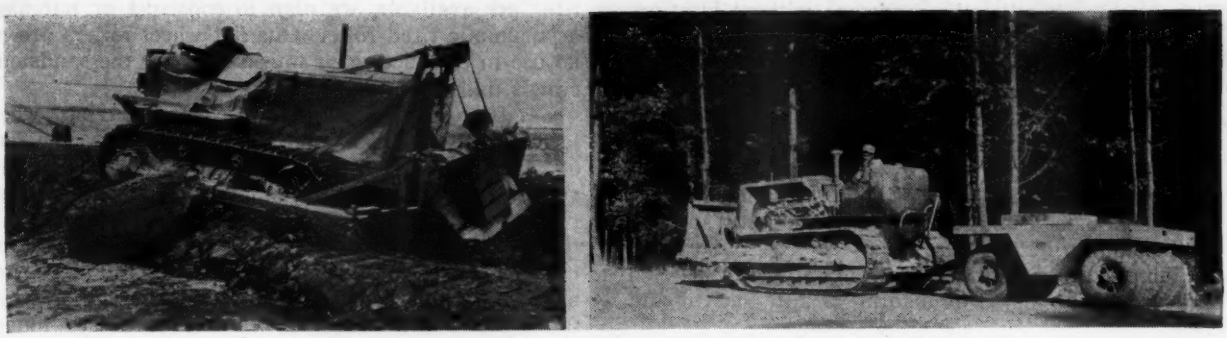


Fig. 2. Results of increasing chlorine dosage at MacDill Field, Fla.



Types of equipment used in the work described in the accompanying article.

Using Sandstone As a Road Base Material

Study by a Texas County of a loal material and its proper use saves money and results in good highway construction

By E. L. ANDREWS
County Engineer, Wichita County, Texas

PRACTICALLY all sources of natural deposits of road gravel in the eastern half of Wichita County, Texas, have been exhausted. There are about seven hundred miles of county roads within this area, and the use of the only remaining surfacing material—sandstone—has now become imperative.

The sandstone, of course, has always been available in this area in fairly abundant quantities; but as long as the native clay-gravel was available, we were reluctant to use the sandstone, even for small maintenance or patching jobs. Toward the end of the gravel supply we found ourselves hauling this material as far as fifteen miles, whereas sandstone was available with short hauls. To put it plainly, we did not know much about this material and were afraid to try it.

The time finally came in 1937 in one area of the county where sandstone had to be used. After the pit was stripped the material was scarified, windrowed with a tractor and blade, and hand loaded. Our plans called for an 8-inch loose thickness, which compacted to 6 inches. The asphalt crew followed behind the compaction. After one mile was completed, base failures showed up. The base was checked carefully and the failures were found to be due to spots of excess clay and soapstone. The clay and soapstone were practically the same color and appearance as the sandstone, making it difficult to detect at the pit. However, the men started watching the material more carefully and practically eliminated the failures. After this first venture, we started using sandstone more and more until it is in general use now.

The Texas State Highway Department has used sandstone for base material on several highway projects. The City of Wichita Falls used it on runways in their airport expansion program just before the war, and also uses it on streets. Cement stabilized sandstone was used for streets in a large military establishment near Wichita Falls. The use of this material has proved that it is as good as the average of all types of flexible base materials.

The District Office of the Texas State Highway Department in Wichita Falls has run numerous series of laboratory tests on sandstone, and the results of these tests have been made available to us for our county work. The highway officials are very cooperative, and their advice is invaluable. The County does not have the personnel or equipment to maintain a testing laboratory. Therefore, technical details in this article will be rather second-hand information. But we do want to give the results of a laboratory test which is about average for our sandstone:

Liquid Limit	24
Plasticity Index	4
Field Moisture Equiv.	20
Centrifuge Moisture Equiv.	10
Shrinkage Limit	20
Linear Shrinkage	2.9
Shrinkage Ratio	1.69
Soil Binder	94

Percent retained on square mesh screens, #40 sieve, 6; #60, 7; #100, 12; #200, 69. Soil binder, #40 and #60, none; #100, 6 and #200, 67. Grain diameter, in mm., 0.05, 77; 0.005, 87; 0.001, 96. Soil binder, 0.05, 76; 0.005, 85; 0.001, 95. Specific gravity of sample and soil binder, 2.69.

In general, the sandstone in the pit is fairly soft, especially just after stripping when moisture is present. Only small sections of a pit are stripped at a time in order to conserve moisture. By way of explanation of the statement that the material is fairly soft, the lumps cannot be crumbled with the hands but will break into smaller pieces when dropped on something hard. The material is worked rather easily in the pit.

In one precinct, the uncovered material is usually scarified with a scarifier attachment mounted on an old mechanical grader, but sometimes with a heavy Killefer scarifier. The material is then windrowed with a motor grader. Loading is accomplished by means of a belt loading attachment on an Austin-Western #99 motor grader (rear-end loading). This method requires a comparatively long pit, but is very cheap and fast. No blasting is used in this precinct.

In Precinct No. 1, a Speeder IS-40 Dragline with ½-yard trench-hoe attachment is used for loading.

This machine handles the sandstone without blasting, but we determined last year that loading could be speeded up some 33% by blasting. Therefore, a 105-cubic foot Gardner-Denver air compressor and jack-hammer were purchased. On the average, holes are drilled six feet deep on approximate twenty foot centers, and from two to four sticks of dynamite are used in each hole. The blasting is limited to each day's run to conserve moisture. The blasting has not only speeded up the loading but has also improved the gradation of the lump sizes to compare favorably with crusher run material. This method of loading is also efficient and cheap.

The material is dumped on the road at a rate to secure from 6 inches to 10 inches compact thickness, depending upon anticipated traffic conditions. In general, we use a theory that the sandstone has approximately 25% less load bearing capacity than clay-gravel.

The material is spread and shaped the same day it is placed in order to conserve moisture. Caterpillar tractors and Galion and Austin-Western mechanical graders are used for spreading and shaping. The tractors are of great benefit in breaking up the larger pieces. Subsequent shaping and finishing operations are performed with Caterpillar and Austin-Western motor graders.

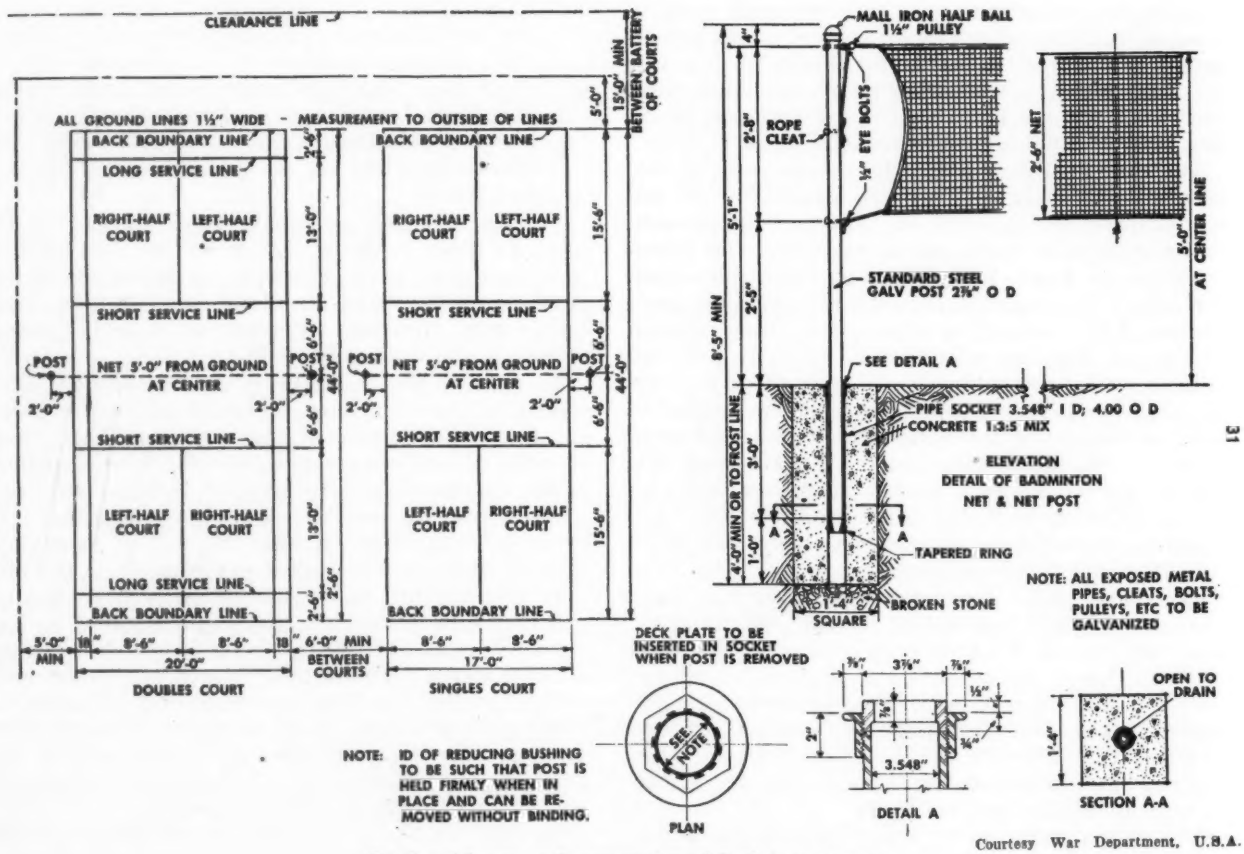
The large pneumatic tires on the motor graders give excellent results in setting up the material and in securing good compaction. Sheep-foot rollers are very often used for compaction. As soon as materials and tires are available, we plan to construct or purchase a pneumatic tired roller. Our flat wheel rollers are of no use in compacting or finishing, since the sandstone crawls under the flat wheels.

Sandstone makes a good all-weather surface when left open, especially in wet seasons. However, the rate of loss and the roughness in extremely dry seasons are very objectionable. Due to our prevailing winds, these two conditions are much worse on the north-south roads than they are on the east-west roads. As high as 20% of a base has been blown away during one dry summer. The surfaces become pitted and rough during these periods. Blading is detrimental except immediately after a rain.

We have just completed fifteen miles of asphalt surfacing on sandstone base, and the results of this work, along with the results of previous similar work, bear out the fact that sandstone is a good base material. In preparing the base for priming, we have found that the least possible amount of watering and blading gives the best results. If the original compaction is disturbed, it is rather difficult to tie the top material back down again. Pneumatic rolling is essential. A heavy prime coat is required; we use from 0.3 to 0.35 gallon of MC-1 per square yard. It is also very necessary to keep off all traffic while preparing the base and until the primer has completely cured out.

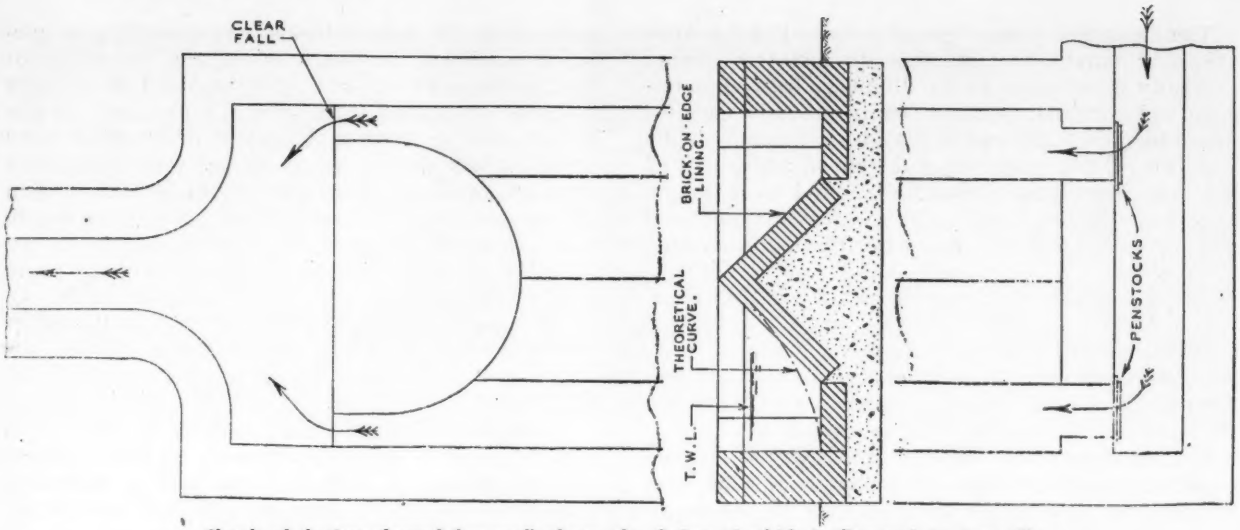
We still wish for a good clay gravel with a short haul, but have to admit that we have a good substitute in sandstone which we have been using with economy and satisfaction.

Layouts of Playgrounds and Athletic Fields


CLEARANCE LINE
ALL GROUND LINES 1½" WIDE - MEASUREMENT TO OUTSIDE OF LINES
BACK BOUNDARY LINE
LONG SERVICE LINE
RIGHT-HALF COURT
LEFT-HALF COURT
SHORT SERVICE LINE
POST
NET 5'-0" FROM GROUND AT CENTER
LEFT-HALF COURT
RIGHT-HALF COURT
5'-0" MIN
DOUBLES COURT
BETWEEN COURTS
SINGLES COURT
15'-0" MIN BETWEEN BATTERY OF COURTS
MALL IRON HALF BALL 1¼" PULLEY
ROPE CLEAT
½" EYE BOLTS
STANDARD STEEL GALV POST 2⅞" O D
SEE DETAIL A
PIPE SOCKET 3.548" I D; 4.00 O D
CONCRETE 1:3:5 MIX
4'-0" MIN OR TO FROST LINE
TAPERED RING
BROKEN STONE
SQUARE
2'-6" NET
AT CENTER LINE
ELEVATION
DETAIL OF BADMINTON NET & NET POST
NOTE: ALL EXPOSED METAL PIPES, CLEATS, BOLTS, PULLEYS, ETC TO BE GALVANIZED
DECK PLATE TO BE INSERTED IN SOCKET WHEN POST IS REMOVED
SEE NOTE
NOTE: ID OF REDUCING BUSHING TO BE SUCH THAT POST IS HELD FIRMLY WHEN IN PLACE AND CAN BE REMOVED WITHOUT BINDING.
PLAN
3.548"
DETAIL A
OPEN TO DRAIN
SECTION A-A

Courtesy War Department, U.S.A.

Details of layout and construction of badminton courts.



Sketch of detritus channel for small plants, the design of which is discussed on page 38.

Detritus Settlement Possibilities for Small Sewage Works

The desirability of detritus removal in small plants and the possibility of adapting the constant velocity detritus channel to plants of any size. Calculation of dimensions of such a channel.

THE separate removal of detritus prior to sludge settlement has been practiced since the early days of sewage treatment, because the comparatively heavy solids, particularly good detritus, would otherwise lead to difficulty in sludge removal from the sedimentation tanks. With the increased use of hopper-bottomed tanks and mechanically cleansed tanks, this separate removal of detritus has become even more important. But for a long time detritus removal, more especially at the smaller works, has been an objectionable process because, in settling the mineral matter of which detritus should be principally composed, heavy organics were also deposited unless special precautions were taken to separate them, and this mixture sometimes became septic.

Dissatisfaction with the simple form of detritus tank has grown, but at the small works the old form of tank with minor modifications has continued to be used because of a widespread belief that there was no satisfactory alternative. Unfortunately, it is at the small works that detritus tanks are most likely to give trouble, for in the absence of mechanization they are liable to be neglected, and neglect is encouraged by a common practice of designing the tanks to too large capacity. The last fault is probably due to an erroneous belief that the Ministry of Health requires a minimum capacity for detritus tanks, but the position has not been helped by occasional statements (so far as the writer is aware not supported by any arguments or evidence) to the effect that a method which has been found satisfactory on a large scale is not applicable to small works. The purpose of the present article is to combat this suggestion and to give some information on what has been done towards the improvement of detritus settling plants for small works.

The method in mind, "the constant velocity detritus channel," can be, and has been, applied to detritus settlement, not only at the largest sewage treatment works, but also at that smaller class of works which in number so greatly exceeds the larger installations.

The simplest and the most effective type of constant-velocity detritus channel, the parabolic channel, the outflow from which was controlled by a rectangular standing-wave flume, was first designed by C. B. Townend and first used at the Mogden works.

The principle involved in the constant-velocity detritus channel is that, at a velocity of 2/3 to 1 ft. per second, the flow of sewage scours away light solids, including the greater part of the organics, but permits detritus, from the largest gravel to a comparatively small-gauge sand, to remain settled. If the velocity of the flow of sewage can be kept, at all times, between these limits, detritus, apart from a small quantity of fine silt, will remain settled while nearly all offensive matter will be washed away to the sedimentation tanks.

In earlier designs for constant-velocity channels, various devices were installed, varying from a series of parallel channels controlled by penstocks to channels with elaborate outlet control. All these methods involved some considerable variation of velocity, together with a need for careful attention. None was found to be suitable for use at small works. They were hampered by the general tendency of designers to adhere to the channel of rectangular cross-section.

Townend broke from tradition. He first assumed that the depth of flow would be controlled by a simple rectangular standing-wave flume, and then so formed the cross section of his channel that at all depths, and consequently rates, of flow the velocity remained constant. This meant that the cross section of channel had to assume the form of a parabola, the invert being level with the invert of the flume.

The theoretical proportions of a channel of this form are easily found. The depth depends on site conditions; generally it is limited by the difference between maximum and minimum depth of flow permissible. On sites where there is little head to play with, this may be no more than the depth between the crown and invert of the incoming sewage. Townend showed by a simple calculation that the width of the parabola at water level at any rate of flow was given by the simple formula $X = \frac{3Q}{2H}$, where Q = flow in cu. ft. per sec., H = depth of flow above invert of channel and flume in feet, X = width of channel at water level in feet. By this formula the size of channel required to accommodate the maximum rate of flow could quickly be found.

Having determined the width and depth of channel required to accommodate the maximum rate of flow, the designer then had to check whether the cross section of the flow at daily peak rate was reasonable. If this proved to be a shallow and wide stream in which large solids would strand near the edges, conditions could be improved by forming the invert as two or more parabolic channels with depth as before, but with a total width equal to that required for one channel.

Preferably sewage should be screened immediately before entering the detritus channels, the screen chambers being so proportioned that grit cannot settle in them; the screens will tend to reduce the eddying caused by the reduction of velocity from the self-cleansing velocity of the incoming sewer. But in any case the sewage will enter the detritus channels in a turbulent condition, and it may therefore be assumed that the first part of the length of the channels serves solely the purpose of stilling the turbulence of entry. There is, however, on this matter, practically no accurate information, and consequently up to the present no specific length for this purpose has been allowed.

The length of channel required to settle the detritus is also not a matter of exact determination. As those who have studied the complex theories of sedimentation will know, there is no critical point at which settlement becomes complete or beyond which it can be said that no appreciable additional settlement takes place. A sedimentation tank of moderate size may do good work; a considerably larger one may have but a slightly improved performance. One therefore has to accept the position that, whatever period of settlement is allowed, some sediment will pass beyond the tank or channel, and that whatever basis of calculation is used it will be founded on assumptions not altogether borne out in practice.

As regards the sedimentation of detritus, conditions are much more simple than those which apply to the settlement of sludge. In this case Hazen's theory (which, so far, has not been of too much practical use in the design of tanks for settling the particles and colloids) may be applied. This boils down to the simple principle that, assuming the turbulence of entry is sufficient to raise some of the smallest particles to the surface, these particles must, after turbulence has subsided, have time to fall to the invert before they are swept out of the channel. A common assumption has been that the smallest particle to be settled falls at a rate of 1 ft. in sixteen seconds.

There does not, however, appear to have been any accurate information published on the smallest size of particle that remains unscoured at a velocity of 1 ft. per second, and as the smallest particle to be settled should theoretically be the same as the smallest particle that remains settled, the above assumptions remain assumptions. It should also be remembered that a turbulent condition must exist throughout the length of the channel as a result of the friction due to flow, apart from the perisisting turbulence of entry, and this, as well as serving the useful purpose of scouring away organics, will delay settlement and reduce efficiency of sedimentation. The conclusions to be drawn from these observations are that it is not possible accurately to determine the required length of channel by theory of sedimentation, but that all this theory can prove is that a length no greater than that required for the smallest particle to fall from the surface to the invert during the time of flow from inlet to outlet is not sufficient, and that a considerably greater length should be assumed.

A length of channel is also needed, in addition to that required to permit settlement, to store detritus between periods of cleansing. The bulk of settlement takes place towards the inlet end of a tank or channel. Consequently a time arrives when the deposit towards the inlet end restricts the cross sectional area of flow (particularly at low rates of flow), so as to increase the velocity sufficiently to cause scour. The effect of this is that the bank of detritus is moved downstream, and spread out until the reduced velocity no longer causes scour. In time the whole length of the channel will have an even depth of silt, and any further settlement will be prevented. If the channel is short the whole length will quickly become silted in this manner, and the periods between times of cleansing will have to be short. But if the channel is made long its capacity for storing silt will be proportionately increased, permitting less frequent cleansing.

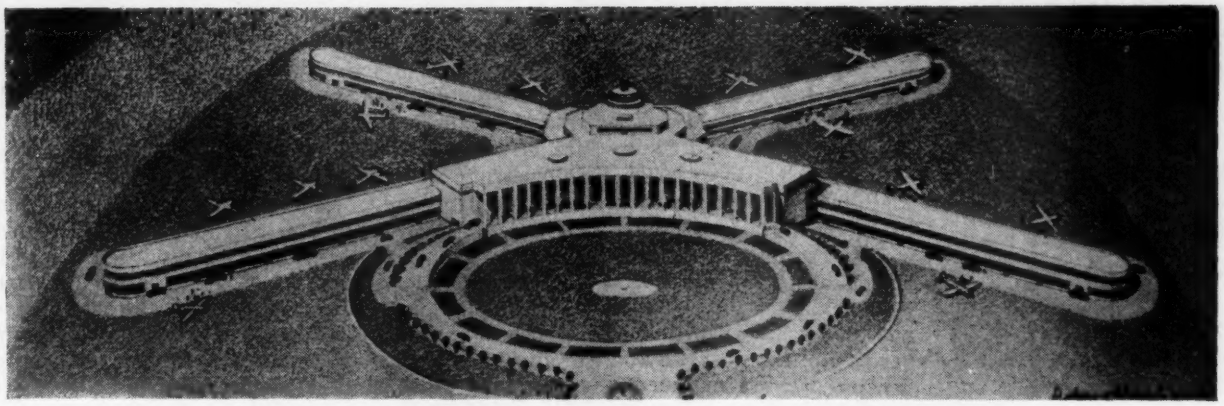
With knowledge of the amount of detritus likely to be deposited per day, it will be possible for an estimate to be made of the length of channel required for storage. However, this quantity varies considerably from one works to another, and therefore in the design of new works some assumption has to be made.

It is suggested that unless coarse grit only is to be settled and removed frequently, the detritus channels should have a length of not less than thirty-two times the maximum working depth. In the case of small sewage works cleansing will generally be manual, and therefore less frequent than elsewhere, and for this reason long channels are applicable.

The parabolic channel is applicable not only to plants of the largest size, but also to those of very moderate capacities. The questions that remain are: to what extent can the size of channel be reduced and the method practically applied to still smaller works, and how should such channels be designed and operated.

It will be appreciated that the settlement of grit is not a very complex phenomenon, and that it is similar over a very wide range of scale. The sandbanks that form in a river of the greatest magnitude owe their origin to the laws that also determine the formation of the small banks of sand that one frequently sees in a roadside channel. That large- and small-scale depositions of sand, etc., are mathematically alike is proved by the amount of scale model work that has been done in this connection. It is, in fact, possible to predict with no small degree of accuracy, with the aid of small-scale models, the behavior of large tidal estuaries, etc. It would therefore appear that detritus channels could be constructed to almost any degree of smallness, the limits being only those of a practical nature; firstly, the depth of flow should always be sufficient to transport the largest organic solids; secondly, the channels should not be so small that detritus can-

(Please turn to page 36)



Architect's drawing of Administration Building at New York's Idlewild airport.

Design and Construction Procedures for Airfield Pavements

A comprehensive resume of Army practices in the Southeastern States, as abstracted from a paper before the ARBA, covering drainage, base design and surfaces.

By BURTON J. BELL
South Atlantic Division, Corps of Engineers

DECISIONS of the South Atlantic Division, Corps of Engineers in regard to airport surfaces were based on making full use of available local materials and then selecting the proper equipment for producing at low cost and at high rate of speed the type of paving mixture adopted. Stated differently, the supporting power of the site's subgrade, availability of local materials for base and surface, available equipment, the required speed of construction, and the design criteria of the expected wheel loads have largely determined the pavement type on airfields in the southeast.

Grading—Construction of airports has required the handling of large quantities of earth—a million cubic yards or more on some projects. The power shovel, the bottom dump wagon, the hydraulic grader, the bulldozer, scarifier, ripper and sheepsfoot roller are all important and valuable grading equipment. The sheepsfoot roller has been especially valuable in densifying embankments and subgrades where cohesive materials were involved. Some difficulties were at first encountered in securing good compaction of Florida sands. Sheepsfoot rollers did not prove satisfactory. Tractors have been used literally to shake the sand into place to secure the high density which is so essential for sub-bases.

Drainage—Since drainage systems cannot carry off moisture which occurs from capillarity and condensation, owing to the great density required in subgrades and bases, our drainage systems are not designed for subsurface moisture unless there should happen to be subsurface free water present, such as an underground stream.

Paved drainage gutters or ditches placed parallel to and immediately adjacent to the outer edges of the runways, with intercepting catch basins at about 200-ft. intervals emptying into underground pipes have been useful. These have widths ranging from 10 to 25 feet, with the maximum transverse slope of 4 inches in the area adjacent to the inlet. The Army Air Forces were at first afraid that a plane landing crosswise to the runway or on an all-over field, might ground-loop. Tests with several types of planes on several fields, convinced the AAF that this type of construction created no hazard. High water tables have been effectively lowered by installing large canals on the perimeter of the project in addition to the usual conventional drainage facilities.

Paving—There was a decided trend before the war toward lighter and less expensive surfaces for airfield paving. However, within the past four years, the advent of 150,000-pound airplanes has presented the paving engineer with new and greater problems. Obviously, no fixed thickness of runway base and surfacing can be dogmatically prescribed for the reason that the supporting power of subgrades vary in different localities, due to varying soil conditions. Therefore, the thickness of the runway foundation and surface must be based on the subgrade's supporting power, the maximum load expected to be applied, and the magnitude of load applications. While repetitional loadings on airports will not be as numerous as on primary highways, they will, nevertheless, be of sufficient magnitude to require that they be taken into account. Since 1942, the California Bearing Ratio has been used to evaluate subgrades and base courses to determine the combined base and surface thickness.

Bases For Flexible Pavements—There are some acceptable limerocks in southern Georgia, and they have been used there to some extent; pebble soils or clay gravels have also been used. Further north, clay-gravel as well as sand-clay materials have been used in building bases and sub-bases, and have proven satisfactory for the lighter planeloads. In sections of the Carolinas, Tennessee and northern Alabama, crushed stone is satisfactory for any standard load requirement provided sufficient thickness is placed. Commercial slags are available in the Birmingham area, but,

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because of the freight rates and car situation, slag base material has been used to a small extent. Along the Gulf Coast, decomposed reef and clam shell have been available in limited quantities, and have been used with success provided sufficient thickness is placed. All flexible type bases and sub-bases are compacted to at least 95% density by the modified AASHO method.

Asphaltic "Black Bases"—In some sections, "black bases" of asphaltic mixtures have been installed at 5- and 6-inch depths. Florida sands are admirably adapted to stabilization by these methods, and their stability has been greatly improved by admixtures of limerock screenings, prior to mixing with asphalt. It was inadvisable to adopt mixed-in-place methods for wartime construction when seasonal rains were likely to be encountered. One large group of army airfields in western Florida has many thousands of square yards of very satisfactory travel-plant cutback mixes which were constructed during relatively dry seasons.

Surface Courses—For asphaltic wearing surfaces, we employed (1) as high penetration asphalt as possible, consistent with required stability; (2) as rich a mix as possible; (3) low mixing temperatures; (4) a designed mix of reasonably high stability; (5) surfaces of low abrasiveness, and (6) sealed tight, to prevent infiltration of surface moisture.

Many of our airports in south Florida and along the Gulf Coast are in an area of high temperatures. Asphalts of penetration over 120 are soft, and remain soft a long time. Planes tend to displace the surface when turning or parking. To offset this condition, the mix has at times been designed with a higher percentage of 200-material to secure extra stability. However, we dislike too much stability in our pavements for fear they will crack if "loaded down" with 200-mesh dust. It is the opinion that asphalt cement having penetration between 100 and 120 was ideal in all respects for our mixes.

Prime and Tack Coats—Prior to placing the surface course or courses, the base is given a prime coat treatment, generally from .25 to .35 gallons of bituminous material per square yard. Tar has been used in 95% of our work. Primed bases are carefully cleaned before applying surfaces. On some of our projects we have been requiring a light tack coat of liquid asphalt ahead of paving operations. This consists of .08 to .10 gallons of asphalt to the square yard, fogged on.

Binder and Wearing Courses—The best results in construction of bituminous pavements in the South have been obtained with hot-mixed, plant-produced asphaltic concrete. These mixtures have consisted of a wearing course, or a combination of wearing and binder courses as required. Binder and wearing courses consist of coarse and fine mineral aggregates and mineral filler uniformly mixed with bituminous material, and compacted on a prepared base or binder course.

Asphalt Mixing, Spreading and Rolling Equipment—In most contracts, asphaltic concrete was purchased at a stated price per ton in place, with asphalt to be paid for extra by the gallon. The master range of mixing temperature is between 175 and 250° F., with tolerance of 25 degrees. Most contractors carefully control their mixing temperatures, and 225° F., is the standard temperature on practically all projects. Conventional asphalt plants with weight-batching units or with volumetric proportioning and continuous mixing units are allowed in the specifications. In cases involving volumetric proportioning, specifications require a gradation control unit. Central mixing plants having rated capacities of 100 tons per hour have been used on a number of projects, and have produced as much as 2600 tons in a 24-hour day. When Florida limerock has been used in asphaltic mixtures, contractors have in several instances installed two dryers to maintain production. Limerock contains more moisture than other aggregates, and it requires considerably more time to dry and heat it, ready for mixing with hot asphalt cement.

Asphaltic mixtures have been placed by mechanical spreaders. On large projects two spreaders generally operate in echelon, and place two parallel lanes at the same time. The benefit of a hot joint is thus obtained. Rollers closely follow the spreaders. Our specifications require a density of at least 95 percent of the theoretical maximum density for surface courses, and 92 percent for binder courses. Paving runways that are 150 feet wide or wider, presented problems in grade maintenance. Lanes are staked, and the contractors check grades for each lane from these stakes. "Bird baths" or depressions in the pavement are found in the straight edging operation, and excess material is removed or materials are added. Runways or taxiways have been generally constructed on a 1% slope from the center of runway to the edge, with the typical section resembling a housetop, except in a few instances where local conditions have required otherwise.

Good inspection in wartime construction has been a chore. Nevertheless, by using trained bituminous engineers from the various state highway departments, by hiring the services of commercial laboratories, and by teaching field inspectors, satisfactory work has been secured.

Concrete Slab Pavements—Concrete pavements are suitable for the heaviest traffic requirements for most severe climatic conditions and for subgrades of relatively low bearing values. However, the wheel load patterns, intensities of loading and the dynamic effects of engine warming, make questionable the use of concrete pavements on untreated subgrades of low bearing value which good highway practice can safely tolerate. Runway slab thicknesses must be determined by analysis developed for the special stress problem and by laboratory investigations and field tests of the bearing value of the soil. Concrete pavement is preferred for the service portion of aprons and the "turn-around" areas at the end of runways when bituminous construction is employed elsewhere on the airfield. Concrete slabs are placed in a single course of the required thickness, with the surface finished to the section and texture required for a wearing surface.

The design of the slab thickness is in accordance with design curves, giving full consideration to the evaluation of subgrade reaction. The bearing value of the subgrade or base course soil is determined by field tests adjusted to saturated subgrade conditions. To obtain an economical design, the combined cost of a base course and concrete slab is considered and fullest practical use of subgrade stabilization or base course construction is made to develop balanced designs. Mixes for runway pavement are designed to provide

(Continued on page 42)

Water-Borne Disease Outbreaks During 1944

Reports by health authorities of disease outbreaks conveyed through water during 1944.

DATA on outbreaks of disease due to contaminated water during the year 1944, as reported by State and territorial health agencies, have been issued by the Milk and Food Section of the Sanitary Engineering Division of the U. S. Public Health Service. The report covers all states and territories except Mississippi, Missouri, Pennsylvania and Utah. Essential information is shown in the table herewith. More detailed data are given in the notes below, which refer to the numbers in parentheses in the fourth column of the table.

(1) *Dysentery at Elizabethtown, Ky.*—City water had been discontinued temporarily due to storm one day earlier. No safety protective device on frost-proof toilet located on premises.

Gastroenteritis

(2) *Baltimore, Md. (Steamship)*—Water tanks filled at Guantanamo, Cuba. After first day at sea, engineer discovered bilge water seeping into tank supplying water to drinking water system. Crew ordered to discontinue using this water for drinking purposes and to use for washing only. Drinking water rationed by transferring water from one of the other water tanks to covered barrel by means of hose. Water from barrel gave positive tests for coliform organisms. Sample from drinking water supply system at time of investigation negative for coliform organisms.

(3) *Bethel, N. Y. (Camp)*—From inspection, water from the well was thought to be safe, but laboratory examination showed 40,000 bacteria per ml. and MPN of B. coli of 8.8 per ml. Also, after boiling of water was discontinued, there were 5 subsequent cases.

(4) *Bethel, N. Y. (Hotel)*—Water supply was obtained from a lake and chlorinated, but owner admitted difficulty with chlorinator.

(5) *Bethel, N. Y. (Lodging house)*—Chlorinated lake water found to be adequately treated; unimproved dug well found to be highly polluted, all tubes being positive for B. coli.

(6) *Blooming Grove, N. Y. (Resort Lodge)*—Water from a drilled well 50 ft. from a sewer had cross-connection with an unimproved spring supply. Well water found to be highly polluted, with a total count of 440,000 and a MPN of 240 B. coli per ml.

(7) *Fallsburg, N. Y. (Lodging house)*—Investigation rather sketchy, but evidence showed water obtained from a spring was subject to sewage pollution.

(8) *Fallsburg, N. Y. (Lodging house)*—Water obtained from a badly constructed drilled well allowing surface pollution through the hand pump.

(9) *Fallsburg, N. Y. (Cottage colony)*—Water obtained from an unimproved dug well, which showed evidence of pollution.

(10) *Fallsburg, N. Y. (Cottage colony)*—Water obtained from an unimproved dug well 30 ft. from a sewer pipe; also from a drilled well with unsealed

State and Community	Total Cases	Population Exposed	Method of Contamination (Also see note)	Type of Supply	Kind of Treatment
Dysentery					
Elizabethtown, Ky.	4	?	Frost proof toilet (1)	Public	Complete
Gastroenteritis					
Baltimore, Md. (S. S. Vermont)	13	45	Leakage of bilge water (2)	On ship	None
Ramsey Co., Minn. (Industrial Plant)	Approx. 120	800	Plumbing remodeling (27)	Private well	?
Racine, Minn.	75	Approx. 789	Sewage (28)	Raw	None
Southern Minn. (College)	47	220	Back-siphonage (29)	Raw	None
Bethel, N. Y. (Camp)	248	275	? (3)	Private well	None
Bethel, N. Y. (Hotel)	28	60	Chlorinator out of order (4)	Lake	Chlor.
Bethel, N. Y. (Lodging house)	40	60	? (5)	Private dug well	None
Blooming Grove, N. Y. (Resort Lodge)	Approx. 50	100	Cross-connection with spring (6)	Priv.drilled well	None
Fallsburg, N. Y. (Lodging house)	5	30	Sewage pollution (7)	Private spring	None
Fallsburg, N. Y. (Lodging house)	Approx. 40	90	Polluted well (8)	Priv.drilled well	None
Fallsburg, N. Y. (Cottage colony)	35	40	? (9)	Private dug well	None
Fallsburg, N. Y. (Cottage colony)	25	70	Prob. sewage overflow (10)	Private well	None
Fallsburg, N. Y. (Bungalow colony)	40	75	Unsealed sewer 15 ft. away (11)	Priv.drilled wells	None
Fallsburg, N. Y. (Hotel)	17	165	? (12)	Private dug well	None
Mamakating, N. Y. (Bungalow colony)	75	100	Broken sewer (13)	Private dug well	None
Mamakating, N. Y. (Lodging house)	60	80	? (14)	Priv.dug well and spring	None
Providence, N. Y. (Camp)	18	46	? (15)	Brook	None
Thompson, N. Y. (Resort hotel)	26	550	Seepage from septic tank (16)	Private well	None
Thompson, N. Y. (Lodging house)	12	24	? (17)	Priv.drilled well	None
Thompson, N. Y. (Lodging house)	12 Approx.	60	Polluted surface water (18)	Spring	None
Thompson, N. Y. (Hotel)	40	325	Chlorinator out of order (19)	Drilled well and lake	Chlor
Oklahoma (School)	37	350	Cross-connection (20)	?	?
Bay City, Texas	Approx. 1000	6,594	Back-siphonage (21)	Public wells	None
Paratyphoid					
Tannery Town, W. Va.	7	?	Polluted water	Surface	None
Typhoid					
Marion Co., Ind.	5	?	Surface drainage (22)	Private well	?
Ashton, Md.	4	8	Polluted water	Priv.supply	None
Bethel, N. Y. (Boarding house)	9	100	Carrier (23)	Priv.drilled well	None
Portlandville, N. Y.	2	15	Sewage, polluted (24)	Private well	None
Guysville, Ohio	3	165	Carrier	Dug wells	None
Water Borne Not Diagnosed					
Forest City, N. C.	Approx. 500	5,035	Back-siphonage into city storage tank (25)	Public supply	Fil. & Chlor.
Louisburg, N. C.	50-100	2,309	Inadequate chlorination (26)	Public supply	Fil. & Chlor.

Tabular data on water-borne disease outbreaks. Additional data are given in the text.

annular space. There was also a tile sewer pipe, 20 ft. from drilled well, with sewage overflow from another lodging house. Water samples from both wells found polluted, B. coli being present.

(11) *Fallsburg, N. Y. (Bungalow colony)*—Water from two drilled wells, one of which was found to be moderately polluted. This well supplied upper bungalows only, although illnesses occurred throughout colony. No apparent cross-connections between wells, so that water does not adequately explain entire outbreak. A sewer ran 15 ft. from polluted well, which may have explained presence of B. coli in water.

(12) *Fallsburg, N. Y. (Hotel)*—Water obtained from drilled well in which annular space not sealed, and from unimproved dug well, with a pitcher pump and common drinking cup.

(13) *Mamakating, N. Y. (Bungalow colony)*—Water from brook (chlorinated) and from a dug well. Sewage odor noted and a broken sewer pipe found 50 ft. from dug well.

(14) *Mamakating, N. Y. (Lodging house)*—Water obtained from three sources; (1) a spring previously found to be polluted, (2) a dug well, and (3) lake water used only for shower baths. Laboratory reports showed dug well and spring polluted.

(15) *Providence, N. Y. (Camp)*—Water obtained from a brook and piped to kitchen. Pipe plugged on Aug. 9 and opened manually.

(16) *Thompson, N. Y. (Resort hotel)*—Water found by laboratory to be definitely polluted and sanitary inspection revealed two sources of pollution: seepage from up-hill septic tank 20 ft. away, and children threw refuse into water.

(17) *Thompson, N. Y. (Lodging house)*—Water obtained from a drilled well which became turbid and had a fishy odor.

(18) *Thompson, N. Y. (Lodging house)*—All of those ill drank from roadside spring, found to be heavily polluted.

(19) *Thompson, N. Y. (Hotel)*—Water from a small drilled well and from lake. Both supplies chlorinated, although no residual chlorine found in these supplies; chlorinating apparatus discovered to be out of order.

(20) *Oklahoma (School)*—Inspection of plumbing system revealed all toilets of flushometer-valve type, with no syphon or vacuum breakers, and with water inlets located below flood-level rim of bowls. Each night custodian turned off valve of main water supply lines to conserve water and eliminate possibility of rooms flooding in case of leak. Vacuum occurring in line permitted possibility of backsiphonage. Majority of illnesses occurred on first floor, with progressively less on second and third floors.

(21) *Bay City, Texas*—Fire occurred which necessitated heavy draft on a 6-in. main for 1¼ hours. Heavy rain occurring at time, which resulted in overflow of creek over areas of city. Negative pressures could have been experienced with backsiphonage of plumbing fixtures or contamination of mains with polluted surface water through leaks. One of city wells could have been covered with flood waters, with contaminated water entering through vent in well head or through defective casing. Numerous outdoor toilets located within city, contents of which were washed out by flood water. Sewer system constructed with poor grades and subject to surcharge during heavy rainfall. Attempts to chlorinate water supply system following epidemic indicated presence of considerable organic matter and high chlorine demand. Cases of sickness occurred until chlorine residuals obtained in most sections of the city. Onset 24-48 hours.

Typhoid and Other

(22) *Marion County, Indiana*—All cases drank water from well at filling station where there was typhoid.

(23) *Bethel, N. Y. (Boarding house)*—Water used in boarding house obtained from drilled well and found satisfactory. However, water had a "sulphur" odor and many guests did not use it for drinking but obtained water from a well on a neighboring private property. This well water proved polluted, on laboratory examination; obtained by means of a rope and pail. Well unimproved and open to surface contamination. Nearest source of pollution was a garden on which compost made from human sewage was used. Garden located about 125 ft. from well.

(24) *Portlandville, N. Y.*—Patients lived in neighboring houses and used common well between houses. Well water on laboratory examination found polluted. A known typhoid carrier resided in one of the houses and sewage from this carrier, which entered a septic tank 75 ft. from well, may have polluted well.

(25) *Forest City, N. C.*—Complaints received that city water supply had peculiar taste and ordor and that small but undetermined number of residents had vague gastro-intestinal symptoms. Investigation revealed sewer pipe had become obstructed and city waste flowing backward into storage tank at water plant. Surprisingly few cases of illness reported to local health officials and symptoms so mild in most cases as to make reconstruction of outbreak impossible. Chief complaint of bad taste and odor probably arose from fact that waste water from a laundry chief constituent of polluting material.

(26) *Louisburg, N. C.*—Investigation showed city water plant needed certain improvement and water could have had low-grade pollution from time to time due to inadequate chlorination.

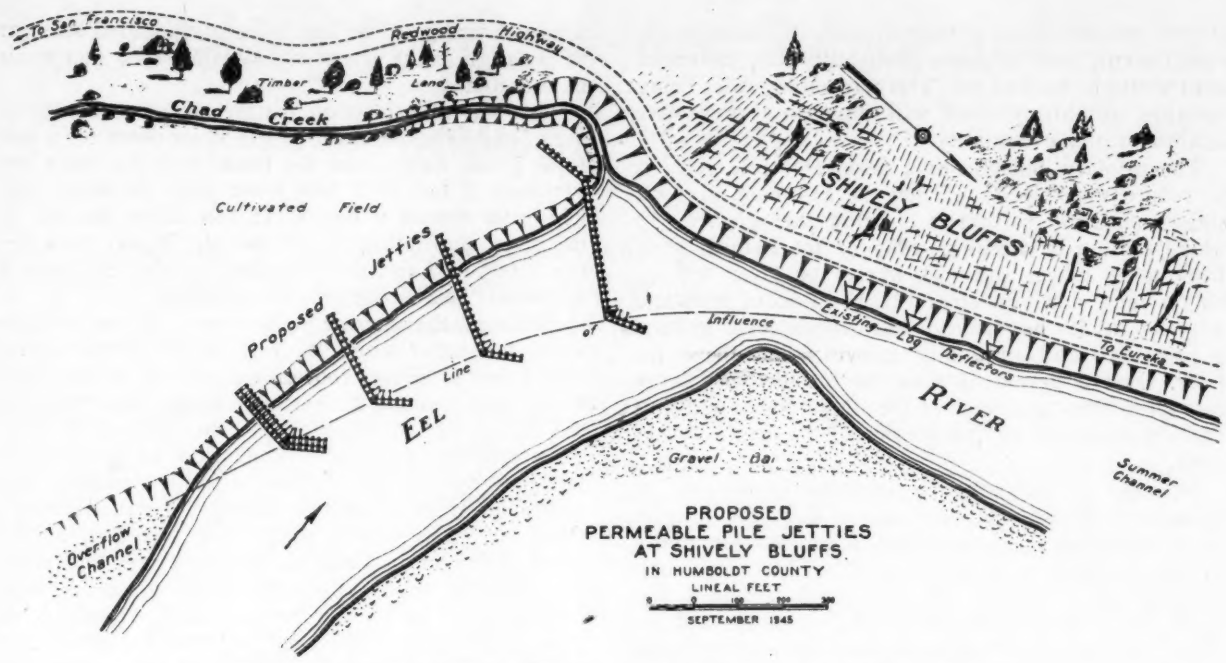
(27) *Ramsey County, Minn. (Industrial plant)*—Thought caused by joint compound used during extensive plumbing remodelling without subsequent pipe sterilization. Water samples positive for E. coli in 100 ml.

(28) *Racine, Minn.*—Outbreak believed waterborne because: (1), explosive, widespread; (2), shallow wells in limestone area; (3) turbid water prior to outbreak; (4), 35 of 42 wells had most probable coli count of 39 per 100 ml; (5), water carriage toilet systems discharged into limestone; (6), five children under 7 mo. using boiled water not sick.

(29) *Southern Minn. (College)*—Water supply in one dormitory suspected on epidemiological grounds. Case distribution supported theory. Plumbing fixtures in this dormitory would allow back-siphonage. Negative pressure developed on principal riser pipe supplying dormitory sufficient to draw significant amount of water from toilet fixtures. Significant negative pressure were not found in other dormitories of institution.

Sewerage Statistics From Minnesota

While 112 Minnesota municipalities have satisfactory sewerage treatment facilities, 216 others require either complete new plants or improvements to existing plants. At the present time, 30 municipalities have employed engineers to prepare plans for treatment plants or improvements to them or to sewerage systems. Harold A. Whittaker, State Board of Health, Minneapolis, Minn., is state sanitary engineer.



Method of protecting Redwood Highway, Calif., from floods by permeable jetties.

Protecting Highways from Damage by Floods

Use of permeable pile jetties to divert a stream from a point where flood water might damage or wash away a highway. Also other methods of protecting such points.

MOST roads in mountainous districts are subject to occasional damage by floods. Where the roads cross the streams, the damage usually takes the form of washed-out bridge piers or abutments or the carrying away of the bridges themselves. Where the roads lie parallel and close to the streams, erosion of the banks of the streams often undermine or carry away a part or the entire width of the road. Repair of the damage may be quite expensive, while interruption of traffic may be an even more serious matter. Therefore prevention, even at considerable cost, will generally be desirable.

Theoretically, the simplest precaution in the latter case would be to keep the road some distance away from the stream. But practically this is not so simple. The greatest danger points are the outer sides of curves, and repeated erosion of these in the past frequently has carried them to the base of the adjacent hills, leaving barely width for a road between stream and hill. The danger is generally confined to the outer bank of the stream at and just below curves, and bank protection at these points only will generally suffice.

This protection may take the form of retaining walls, slope walls, or rip-rap. If the first is used, the foundation should be on ledge rock or carried well below possible erosion depth. Retaining walls of concrete or cemented masonry are the most expensive and would generally be used only where the narrowness of the valley necessitates it. Covering the sloping stream banks with rip-rap or slope walls (which are practically hand-laid rip-rap) may not be very expensive if the rock can be obtained from the hill bordering the road on the other side. Instead of rock, where the curves are not sharp nor the currents in flood too swift, mattresses of willow branches or other material may prevent erosion.

In many wide valleys, the stream is found to have changed its channel with almost every flood, the curves increasing in sharpness and deviation from the median line of the valley until at some time a flood makes a short cut across the base of a hairpin curve, leaving it as a backwater. This progressive movement of a curve can often be prevented by comparatively inexpensive jetties. An illustration of this is described by L. R. Redden, office engineer of the California Division of Highways, in the office journal of the division—California Highways and Public Works. His description, somewhat condensed, is given below.

The Redwood Highway borders the Eel river, high-water stages of which reach 40 ft. and more above low water, and this, in combination with extremely high velocities, results in rapid and destructive erosion at many points. One of these is at the confluence of South Fork of Eel river with the Main Eel. Here permeable pile jetties were used and the results were so encouraging, a similar installation is now being made at Shively Bluff, about seven miles downstream.

A progressive and accelerating erosion at Shively Bluff has finally reached the point where some damage to the embankment slopes has been caused by the river during the past two or three years of moderate flood

stages. Should a heavy rainfall and attendant heavy runoff occur, there is grave probability that the entire road would be washed out. The permeable jetties being installed at Shively Bluff will serve as a preventive against such an eventuality.

The primary function of a permeable pile jetty is to reduce the velocity of flow of a stream in flood stage sufficiently so that it is below the velocity (1) where erosion or washing away of the natural river bank takes place, and (2) where the river will no longer carry down the stream its bed load of sand and gravel particles but, instead will deposit them to form a protective and gradually growing bar above the jetty. Over a period of time the bar becomes large enough to turn the course of the stream away and thus provide protection against erosion of the original river bank.

In order to accomplish a reduction in velocity, as opposed to a complete stoppage of flow, the jetty is purposely constructed very open. It consists essentially of two to three rows of piles on which are strung barbed wire. The rows of piles are 6 feet to 8 feet apart; the piles in each row are 8 feet apart; and the wire is strung horizontally at 6 inches to 12 inches centers. The rows extend into the stream perpendicular to the direction of flow.

The resistance to flow presented by the widely spaced piles and the wire (on which small debris will impale itself), is designed to be open or "pervious" enough to readily permit flow of flood waters, but still offers sufficient obstruction to the current so that it will be reduced to less than that critical velocity at which the force of the water carries along with it considerable quantities of sand and gravel on the bottom or bed of the stream. Thus the stream is induced to deposit this bed load above and below the jetty, forming eventually into the characteristic sand and gravel bar.

One item to guard against is the setting up of eddy currents so large in magnitude as to overcome the moderating effect on the current. Thus, placing the piles too close together, plus the greater likelihood of debris lodging against them, causes the jetty to act like a dam, as a consequence of which disastrous eddy currents are set up, scouring occurs, and the desired result is not obtained.

The Shively Bluff installation consists of four jetties which are being installed at a bend in the river. Beginning at the upstream end, the jetties are spaced 255 feet, 300 feet and 355 feet apart; and they extend into the river distances varying from 127 feet to 312 feet, with the outer end conforming to a predetermined curving "line of influence." It is expected after construction, that eventually the main current at high water stages will conform to this line of influence. To minimize the effects of eddy currents at the outer end of the jetties, wing extensions, set at 30 degrees to the designed line of flow, are being constructed.

Three of the jetties consist of two lines of piles 6 feet apart. The fourth or upstream jetty consists of three lines of piles, the two upstream lines of which are 6 feet apart, and the third line 8 feet downstream from the second. The additional line in the upstream jetty, which receives the first impact of the stream, provides added resistance against the current. Wales and braces bolted near the tops of the piles, and diagonal bracing in the case of the upstream jetty, provide additional strength.

At the point where the wing extension joins the main jetty, five additional piles are being driven as brace piles, with cut-off 2 feet above stream bed. Diagonal bracing to the line piles gives added strength to the angle point where considerable stress and strain is anticipated.

The "cut-off" elevation for the river bed section of each jetty provides for a gentle slope down on a uniform grade away from the bank, with the outer end variously 2 feet to 9 feet lower than the inner end. The piles extend 9 feet to 15 feet above the bed of the river, depending on its contour. Heavy rock rip-rap 2 feet to 3 feet thick is placed around the piles to minimize "bed" scour around the piles.

Although the extreme high water is 40 feet or more above low-water stage, the piles in the jetties extend only 9 feet to 15 feet above the river bed, so that heavy drift, most common at maximum stage, may float over the jetties without damaging them. Such drift sometimes consists of entire redwood trees as much as 300 feet long and 10 feet or more in trunk diameter. Such enormous trees possess a terribly destructive force when carried swiftly by the current; hence the importance of providing adequate clearance over the jetties. If debris of such magnitude struck against a jetty, failure would be a foregone conclusion. Moreover, the primary function of the jetty, as above explained, is to induce and encourage the formation of a gravel bar from the bed load carried by the stream, and hence no useful purpose would be served by extending it up to maximum flood elevation. As a matter of fact such construction might only insure the failure of the jetty from the destructive forces of the current, if not from the drift.

From the inshore end of the riverbed section, and structurally a continuation of it, the grade of the jetty rises steeply, conforming approximately to the slope of the bank, and extending above it 6 feet to 15 feet. At the top of the bank the grade again changes, with the top of the jetty being level, and about 5 feet above the ground. The three upstream jetties extend back of the top of the bank 25 feet to 30 feet to effect an anchorage; the fourth jetty extends 128 feet back of the top of the bank to minimize the influence of a small stream which enters the river immediately down stream from jetty.

Barbed wire is to be strung at 8 inch centers on the upstream row of piles in each jetty, and the placing of medium to heavy rock rip-rap around the piles to prevent erosion completes the installation.

Pathogenic Bacteria in Sewage Sludge

Throughout the war, the Water Pollution Research Laboratory of England maintained close contact with the Agricultural Research Council, which has been responsible for initiating a great deal of work bearing on the agricultural utilization of sewage sludge. Reporting on this recently, B. A. Southgate said:

"The Water Pollution Research Laboratory collaborated in an investigation of the viability of certain pathogenic bacteria during the drying and digestion of sludge. There is much further work to be done on this, however, before the risk or lack of risk arising from the use of sludge as fertilizer can be properly assessed. One difficulty at present is that methods of determination of pathogenic bacteria in so complex a mixture as sludge are not very satisfactory. When further advances in the technique of counting these bacteria have been made by the medical profession or by other bacteriologists the opportunity will be taken of continuing the work by observing the fate of pathogenic bacteria during the processes of treatment as ordinarily carried out at a sewage disposal works.

Making Fertilizer from Refuse and Sewage Sludge

Reports of English investigations and research on methods of cell digestion of municipal refuse and primary sewage sludge having 94.5% moisture, mixed in varying proportions.

IN 1940 a grant was made to Reading University, England, by the Agricultural Research Council for investigations on the preparation and nature of composts made from municipal refuse and sewage sludge. In November, 1945, C. Bould, of Reading University, presented a paper before the Institute of Sewage Purification describing some of the investigations and results. The following is an abstract of those portions of that paper that describe methods and conclusions.

Six cells 5′ x 5′ x 4′6″ deep were constructed to hold the compost. These were of concrete and water tight.

The refuse as collected in trucks is dumped onto a grid with a 2″ x 1¾″ mesh, where it is forked over and bottles and other salvable materials removed. Most of the ash and some cinders and small organic matter drop through the grid. The refuse remaining on the grid is then fed into a crusher, which discharges it onto a conveyor belt. The upper pulley of this belt is magnetic, and tin cans and other ferrous materials are held to the belt as far as its under side, where they fall off, while the non-ferrous matters drop directly at the end of the conveyor. A sample of this waste showed 17.7% paper, 3.3% rags, 2.3% coke and coal, 3.1% glass and porcelain, 6.4% rubber and wood, and 8.4% unidentified matter retained on a ¼″ mesh, and 56.8% passing it, of which 33.4% was lighter than water.

The sludge used was that from the primary sedimentation tank at the Maidenhead sewage works, with 94.5% water content. On a dry weight basis, the refuse and sludge were mixed in proportions varying from 21.0:1 to 13.1:1. Using averages from British communities, the pulverized refuse from any given town would probably be insufficient in amount to absorb all the liquid sludge of the town unless this had a water content below 95%.

The initial stage of decomposition was aerobic, to prevent obnoxious odors, which was effected by under-aeration through filter bed tiles. A uniformly high temperature developed throughout the compost in cells with under-aeration, reaching a peak value of approximately 65 deg. C. the sixth day after turning. After three weeks in the aeration cells the compost was free from obnoxious smell. Compost without under-aeration took about ten days to reach a peak temperature of about 50 deg. C., and after three weeks it still smelt strongly of sewage sludge. The initial moisture content in each case was 60 per cent of the fresh weight.

Losses of organic matter were greatest during the initial stages of decomposition. Aerobic conditions resulted in increased losses. Minimum losses of organic matter occurred when the initial aerobic period was limited to two weeks followed by a period of covered anaerobic storage.

In one experiment liquid sludge was added to refuse in varying amounts so as to bring the final moisture content to 50, 60, and 68 per cent respectively. All composts were underaerated. Composts with original moisture content of 50 and 60 per cent fr. wt. had a good texture, were free from smell, and the condition was such that they could be bagged (moisture content =32 per cent). Compost with an initial moisture content of 68 per cent appeared "sticky" when sampled and smelt strongly of sludge. The stickiness was still noticeable after fourteen weeks.

Temperatures of composts with original moisture contents of 50 and 60 per cent rose rapidly reaching a maximum of 76 deg. C. three days after mixing, whereas the temperature of composts with 68 per cent moisture did not exceed 55 deg. C.

Increasing the amount of sludge so as to raise the initial moisture content from 50 to 68 per cent increased the original nitrogen content from 1.22 to 1.32 per cent (dry wt.). However, after five weeks the respective nitrogen contents were 1.183 and 1.114 per cent and after fourteen weeks 0.960 and 0.875 per cent dry wt. The extra nitrogen, therefore, which the increased amounts of sludge contributed was lost during decomposition.

The losses of total nitrogen during the first aerobic period of five weeks varied from 14.7 to 19.2 per cent and during the second period (without aeration) of nine weeks a further loss of from 13.8 to 23.8 per cent occurred.

The maximum amount of sludge which could be added to that particular refuse without detrimental effect on aeration and the physical state of the compost, was approximately equal parts of fresh weight. The refuse was low in organic matter (40 per cent loss on ignition) so that with a better type of refuse the ratio might be increased to 1.5 or 2.0. Using approximately equal parts by fresh weight the refuse contributed twenty times more dry matter than the sludge and approximately five and a half times more nitrogen and nine times more P_2O_5.

In the present investigation losses of nitrogen have always occurred during decomposition, in some cases amounting to as much as 43 per cent of the total. In order to reduce these losses to a minimum it is recommended that the initial aerobic period should not exceed two weeks, and this should be followed by a further storage period under partial anaerobic conditions for one or two months, or until tests indicate that the compost is mature.

It is important to know when composts are sufficiently mature to apply to land about to carry a crop. If insufficient decomposition has taken place soil nitrogen may be immobilized with detrimental effects on plant growth. Considerable time and experimentation have been spent on this problem, and methods have been devised, or modified, to indicate the state of

maturity of compost. It may be taken that a compost will not immobilize soil nitrogen if it satisfies one or more of the following conditions:

1. The "corrected" carbon/nitrogen ratio is less than 20.
2. The nitrogen, expressed as a percentage of the "loss on ignition" is greater than 3·0 per cent. It usually becomes stabilized around 3·5 per cent.
3. When mixed with soil and kept at optimum moisture and temperature conditions nitrates are liberated (nitrification test).
4. When mixed with an equal quantity by dry weight of cellulose, and given optimum conditions of moisture, aeration, and mineral supply other than nitrogen, increased evolution of carbon dioxide takes place (fermentation test).

In the light of these investigations it is possible to indicate the general lines on which a large-scale plant might be constructed. In order to produce compost at a reasonable price it is felt that a specially designed mechanized plant is necessary.

1. Particular attention must be paid to the salvage and preparation of a pulverized refuse high in organic matter. After tipping the refuse from collection lorries into hoppers, it should pass into enclosed rotary screens for the removal of fine ash. The size of the mesh might have to be changed with the seasons. A useful size for removal of fine dust would be ⅜-in. mesh.

2. After screening, the refuse should pass on to conveyor belts where salvage of large paper, rags, bottles, wood and metals should take place.

3. The refuse should then be pulverized in some form of crusher, but not too fine as to impede aeration.

4. Some attempt should be made, either before or after crushing, to separate larger particles of coke, coal, and mineral matter from the vegetable matter. It has been suggested that this could be accomplished by allowing the material to fall on the conveyor belt, the angle of which from the horizontal could be adjusted so as to retain the flat organic matter and cause the heavier rounded particles of mineral matter to fall off.

5. Control should be exercised over the proportions of refuse and sludge used. The pulverized refuse might first be fed into a hopper of known capacity.

6. The refuse and sludge should be intimately mixed in a mechanical mixer prior to being transported to the aeration cells.

7. Cells constructed of concrete, or brick, should be provided with aeration channels in the floor. Until more information is available the depth of the cells should not be much greater than 5 ft. if natural under-aeration is employed. The cells should be large enough to take the maximum supply of refuse for one to two days. Assuming a six-day working week, and an aerobic period not exceeding two weeks, then seven or more cells would be required. The last cell would be in the process of being filled whilst the first one was being emptied.

8. Adequate storage space should be available for maturing the compost, preferably under cover. No definite rules can be laid down with regard to the length of this second period since the demand for compost would be greatest in Autumn and Spring. Since the availability of the nitrogen in mature composts is low, in certain cases better results might be obtained by using the compost while the ammoniacal nitrogen content is high, but more information is required on this point before it can be recommended.

Army Safety Requirements for Ropes, Cables and Chains

1. Fiber ropes used to support a human load shall be inspected before each use. Visual inspection shall be made for abrasion, broken fibers, cuts, fraying, or any other defects. Fiber ropes found to have defects under such inspection and examination shall be removed from such service.

2. Ropes, cables, and chains shall not be used for stresses in excess of the allowable stresses given for each.

3. Wire ropes or cables shall be inspected at the time of installation and once each week thereafter, when in use, and removed from hoisting or load-carrying service when any one of the following exist:

(1) When three broken wires are found in one strand of 6 x 7 wire rope;
(2) When six broken wires are found in one strand of 6 x 19 wire rope;
(3) When nine broken wires are found in one strand of 6 x 37 wire rope;
(4) When eight broken wires are found in one strand of 8 x 19 wire rope;
(5) When marked corrosion appears;
(6) Wire rope which has been idle for 3 months or more and subjected to water, moisture, dampness, etc., shall be cut off and inspected for internal corrosion, and if marked corrosion is found it shall be removed from hoisting or load-carrying service;
(7) Wire rope not mentioned herein, shall be removed from load-carrying service when 4 percent of the total number of wires composing such rope are found to be broken.

4. Wire ropes or cables removed from service under the requirements in items (1) to (7), inclusive, shall not be placed in service again on hoists, cranes, or other such equipment.

5. The ratio between the rope diameter and the block, sheave, or pulley tread diameter shall be such as to allow the rope strands to slide past each other and adjust themselves to the bend. The economical and absolute critical sheave diameters for steel ropes to be considered for any operating rope are shown in the following table. The "Economical Minimum" sheave diameters should be used for all operating hoist ropes. In no case shall the sheave diameter be less than the "Absolute Critical" sheave diameter for any operating ropes as specified below. For cable sizes not mentioned herein, see manufacturers' specifications for corresponding block, sheave, and pulley diameters:

Economical and Critical Sheave Diameters for Operating Ropes

Sizes	6 x 7	6 x 19	6 x 37	8 x 19
"Economical Min." dia. for operating hoist ropes	36D	24D	16D	20D
"Absolute Critical" dia. for any rope	28D	16D	14D	14D

NOTE—D=Tread Diameter of Sheaves.

6. Sheaves or pulleys with eccentric bores or cracked hubs, spokes, or flanges shall be removed from service.

7. Connections, fittings, fastenings, parts, etc., used in connection with ropes, cables, or chains shall be of such quality and strength and so attached, connected, fastened, etc., as to provide a safety factor of not less than four. Standard connections shall be used.

8. Running lines of hoisting equipment, located within 6 feet 6 inches from the ground or working level, shall be boxed, railed off, or otherwise guarded, or the operating area restricted, except when loads are moved horizontally.

Using Stabilized Soil Mixtures Properly

Precautions in use of chemically stabilized mixtures for patching and maintenance of highways.

Experiences in the construction of stabilized roads in Michigan were described by Charles M. Ziegler, State Highway Commissioner, in a paper before the American Road Builders' Association. In the paper, important details in regard to the use of stabilized materials were listed.

Stabilized base course materials should not be placed over high capillary soils without an adequate subbase or other type of capillary cutoff, and should not be used as a maintenance material to patch spring break-up areas. The excess moisture caused by the thawing of accumulated ice lenses will not allow the stabilized material to compact sufficiently to furnish the temporary bridging required to carry traffic over the failed area.

Stabilized material should not be placed in continued wet weather in areas subject to traffic. The soil fines will be brought to the road surface by the action of traffic, and the surface will remain rutted and appear to contain an excess of binder soil. If the material is placed during the rainy season, traffic should be detoured and the material laid toward the plant to avoid construction traffic. After drying, the road may be opened to traffic and continuous maintenance used until the road has been compacted satisfactorily. This ordinarily is not a long period.

Stabilized materials should not be compacted in more than three-inch layers. When layers greater than three inches in depth are compacted considerable warping of the surface alignment may be expected. The mechanical spreaders usually used for black top construction give very satisfactory results in the placement of a stabilized material with optimum moisture. In this case, the compaction period will be shorter and the use of side forms can be eliminated. The construction practice is similar to the type used for black top construction. This method also is desirable because the subbase must be firm to carry the mechanical spreader.

Sand subbases used for capillary cutoff over objectionable soils or light sand subgrades usually require special treatment of the top three inches before placement of stabilized bases. A sandy clay or other suitable binder soil should be added and manipulated into the surface to form a firm base to carry construction equipment and insure a good subgrade and uniform thickness of stabilized material during placement. If the loose sand subbase or subgrade is not given this preliminary treatment, poor consolidation, non-uniform thickness of stabilized material and a distorted surface can be expected because of shifting of the subgrade during placement and compaction of the surface material.

A compaction period of not less than two months of dry warm weather usually is required before bituminous surfaces can be placed satisfactorily on stabilized bases. Generally it would be more satisfactory to place the bituminous material the next season.

The placement of stabilized materials should be restricted during the periods of spring and fall rains. During these periods the stabilized material should be stockpiled.

If stabilized material has been placed over a frozen subgrade, load restrictions should be enforced rigidly during the spring thaw. Careful control should be exercised during subsequent compaction and weaknesses repaired immediately.

The crown for stabilized surface courses should not be less than 5 inches for a 21-foot road, if it is expected to serve adequately as a wearing course during the wet seasons (spring and fall). A flat crown will develop excessive pitting of the road surface from the action of traffic during wet weather. If a base course is to be carried over the winter, provision should be made to increase the crown during the fall, winter and spring seasons of the year. The reduction of crown should be made during the late spring and allowed to compact thoroughly prior to the placement of a bituminous surface.

Adequate side ditches and well-shaped shoulders should be required for stabilized surfaces. When a snow removal problem is involved the snow should be moved outside the drainage ditch. The temporary high water caused by melting snow will, if not caused to drain to the side ditches, cover the road surface and excessive pitting will result under traffic. This condition may cause a serious traffic hazard.

Factors Affecting the Strength of Timber

Its density, the slope of fibre or grain with respect to the direction of the imposed forces, and the presence or absence of knots, shakes and checks are the main qualities that determine the strength of timber.

For any particular type of wood, strength is dependent upon density. Density is measured by the "basic" amount of wood fibre in a unit area. This is most generally ascertained by visually inspecting the surface of a piece cut at right angles to the direction of the fibre or grain. Specifications generally cover the minimum and maximum number of annual growth rings per inch. The cell walls of the fibre that grow in the Spring are thin, and, therefore, low in strength; while the Summer growth of fibre has thick cell walls and is correspondingly strong. The two seasonal growths can be differentiated by the darker color of the Summer growth. The two growths taken together constitute an annual ring. Pieces showing an annual ring count of more than 20 per inch are generally of poor structural quality, since they lack sufficient Summer growth.

Since the greatest strength of timber in either compression or tension is paralled to the grain, the slope of wood fibres with respect to the direction of the stress is of great importance in a piece to be graded for strength. A piece of wood will vary in strength depending upon the angle between the principal line of stress and the axis of the grain.

Knots will affect the strength by the characteristics of their growth, by their position and by their size in relation to the width and depth of the piece.

Shakes are a separation of fibres between the annual growth rings, and checks are similar separations in a

direction radial to the growth rings. Both of these last two defects affect the strength of timber subject to shearing stresses.

The above remarks are abstracted and condensed from an article by T. K. May, appearing in the *Pacific Road Builder and Engineer*, and represent the American Timber Standards of The United States Department of Commerce.

Post-War Problems of English Sewage Works

The manager of an English sewage treatment plant who conceals his identity under the pen name of "Impeller," writing in *"Contractors Record and Municipal Engineering,"* discusses the condition of sewage plants and sewer systems in England after six years of war. Hundreds of instances of damage to sewers by bombs have been reported, but none of the plants damaged by bombing. However, prolonged overloading has produced problems, and concerning these the author wrote as follows:

"Heavy overloads of war industry . . . maintained for lengthy periods, have a severe effect on sewage purification plants. Percolating filters, unless designed on the new "High Rate" principles, rapidly accumulate organic matter in the surface layers of the media, once the margin of safety is passed. To fork over the surface layer will alleviate this trouble by loosening the organic solids, and allowing them to be washed down and through, in theory, to the humus tanks. Not all is washed through, though, and if no other steps are taken to meet the increase repeated forking will produce a filter choked from top to bottom, beyond recovery except by removal and washing of the media; and when this expensive remedy has been applied, be it noted that nothing has been done towards meeting the original overload which induced the condition.

"Activated sludge plants suffer less permanent injury perhaps. Similar overloads are more apt to cause immediate failure of purification. If some activity can be held in the sludge and partial purification maintained, there is still a rapid increase in the day-to-day wear and tear.

"Again, digester plants suffer similar cumulative injuries under prolonged overload. Forcing the primary settling tanks often results in the transfer of heavy grit into the digesters, where it remains to reduce the digestion capacity, and to be dug out by hand sooner or later.

"The quantity of 'indigestible objects' in the surface scum of the digester appears to increase under such conditions also. If heating, gas collection and stirring are practised, there is a limit to the amount of undigested rag, corks, wood, etc., which can be carried in this layer if the mechanisms are to function as intended.

"Such major deteriorations must be widespread today, supplemented by a long list of ordinary mechanical maintenance which has fallen behind during the war. Much has been done to offset these effects, of course, by any manager worth his salt, but much remains to be done.

"The general tendency at the moment is for the war industry loads to reduce rapidly, which gives some breathing space to deal with these heavy arrears. Industry is rapidly reorganizing for peace, however, and sewage purification must deal with such arrears quickly if it is to keep in step and be ready for new peacetime developments.

"During the pre-war years sewage research had reached a very high volume, and rapid strides were being made towards higher efficiencies in sewage purification. The substantial continuation of such research during the war is largely the result of efforts to apply those pre-war advances wherever possible to meet individual pressing wartime difficulties. This means that there is a great deal of knowledge available on new methods of treatment which has not yet been widely applied. The advance in knowledge has not ceased during the war years, but the building of plants embodying those advances has been on a very small scale.

"This imposes a special responsibility on designers today. It is more than ever necessary for designers to study intensively the new methods available. Otherwise it will be distressingly easy to install new works which do not take advantage of available improvements and economies, and which are out of date before they are completed.

"In the hiatus now before us, while we look to see the shape of things to come, while industry and populations resettle themselves, there is a chance to study and assess the new methods. As soon as the shape of new sewage purification loads becomes visible, plans should be in hand to meet them. Local authorities are being encouraged to prepare sites and roads, and to lay sewers in advance for new housing. Those sewers must have an outfall, and their contents given treatment effectively. New industry may well bring much heavier demands on purification capacity than new housing."

DDT for Mosquito Control

Much has been written recently about the successful employment of DDT to combat the insect pests of the islands in the South Pacific. Of its value in combating living insects, such as flies, mosquitoes, roaches, bed bugs and the like, there can be no doubt.

Now it develops that DDT can be employed as a larvicide, either as an oil solution or as a dust. DDT (as Larvicide, DDT, powder, dissolving) is admixed at the rate of seven ounces of powder to one gallon of kerosene or any other light to medium-heavy petroleum fraction. The mixture should be stirred at intervals until the DDT is completely dissolved. The time needed for dissolving may be shortened by placing the mixture in sunlight.

This oil solution should then be applied at the rate of 0.2 pounds of DDT per acre, which is the amount of DDT in two quarts of a five percent solution. The treatment should be repeated every six to nine days. If the water surface is covered with algae, or if there is a heavy growth of vegetation to hinder the spreading of the solution, it is advisable to apply a one to two percent solution at more frequent intervals.

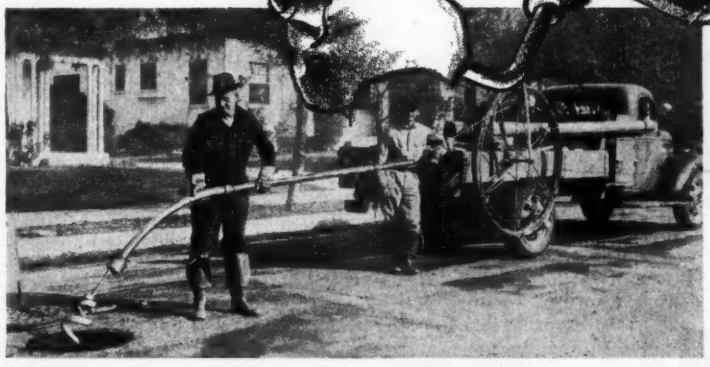
Larger doses than those mentioned above result in "residual" effects that may last up to three weeks. Such dosages are not recommended where wind and rain are likely to break up the surface film. The higher concentrations are likely to kill fish and prove harmful to wild life.

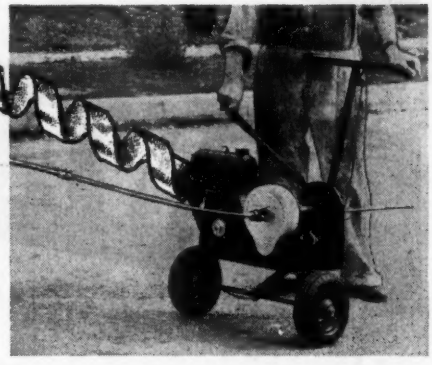
The DDT solution may be applied by the same apparatus employed for oil, the chief requirement being its capacity to produce a fine spray. In the

A Practical PIPE DREAM

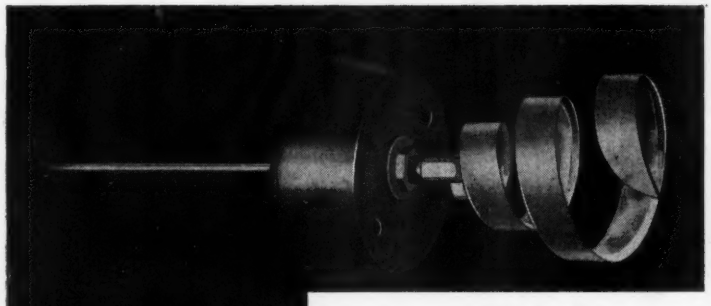
Back in 1934, "the practical pipe dream" or idea of using an auger and flexible rod powered by a motor for cleaning pipe proved successful. In fact, so successful that today 78% of the cities in the United States own and use Flexible Sewer-Rod Equipment.

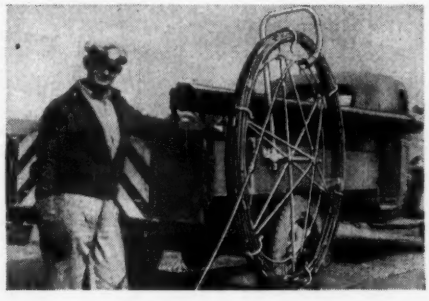
Flexible tools and methods eliminate the time-consuming, hot, unsanitary part of the work. They eliminate more than 50% of the dig-ups once thought necessary. Actually a few men equipped with Flexible tools clean more pipe than an entire crew can using old methods. What is your pipe cleaning problem? Flexible has never been stumped yet on any pipe cleaning job and welcomes your questions. We will be glad to send an illustrated catalog upon request.





Workmen at left are placing Flexible rod guide in manhole with Flexible rod and tool ready for action. At right is power unit.





Root auger at left attached to sand cup is one of the many tool attachments for Flexible Sewer-Rods. At right the Flexible rod is shown rolled on the regular rod reel.

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treatment of streams, a drip-can may be used, and in controlling a large area, specially equipped aircraft may be employed.

Oil solutions of DDT are absorbed by the skin and may cause toxic effects, though apparently occasional contact is not harmful.

Using DDT solutions to spray interiors leaves a highly toxic residue that is fatal for several months to insects exposed to even brief contact. This so-called residual effect is obtained by covering all surfaces with an ordinary paint brush or by spraying to the point of surface wetness without appreciable run-off.

Treated Timber Curbs and Bench Slats Used in Central Park, New York

The New York City Department of Parks maintains a number of walkways, bicycle paths and bridle paths where the surfacing material is retained by timber curbs. Some years ago the department began using creosoted timber for these curbs and the stakes which hold them in place. A standard installation consists of a 2 x 8-in. rail on each side of the path, made up of 20-ft. lengths. Each rail is held in place by four 2 x 4-in. stakes, one 18 in. from either end and one 3½ ft. each side of the center. The stakes are 3 ft. long and are driven flush with the rail top. Joints in the rail are reinforced by a short fishplate of 2 x 8-in. plank 3 ft. long.

The specifications call for southern yellow pine of a 1600#f grade of joist and plank treated with a retention of 12 lbs. of grade one creosote per cubic foot, in conformity with standards of the American Wood-Preservers' Association.

All lumber so far as practicable is cut to length and framed before treatment. Where field cutting is necessary, as on curves, the exposed surfaces are protected by applications of creosote. Two methods of protection are authorized. Field cuts may be given two applications of a mixture containing 60 per cent creosote and 40 per cent roofing pitch, or they may be given two brush coats of hot creosote and then covered with hot roofing pitch.

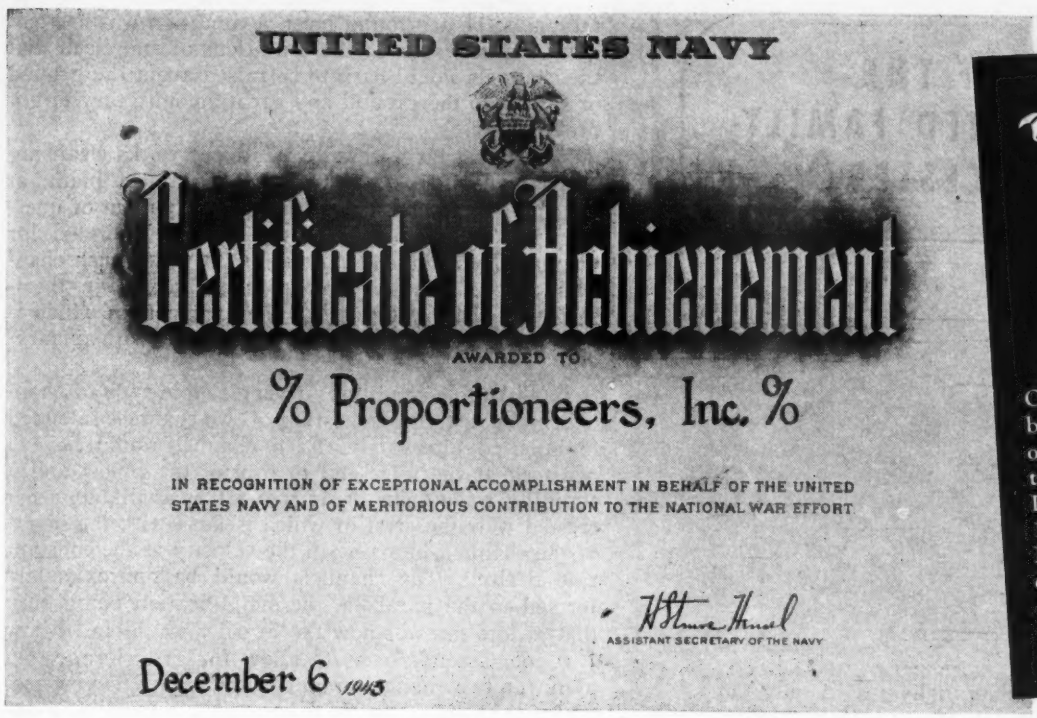
The Department of Parks has also developed an interesting use for salt treated timber. The parks contain many benches with stone or concrete standards and seats and backs of timber slats. Such slats, treated with a standard salt preservative, were installed several years ago on a number of these benches and painted after installation. The slats are B & Better grade dense vertical grain Douglas fir and are worked accurately to the desired profile before treatment. —*Wood Preserving News.*

Detritus Settlement for Small Sewage Plants

(Continued from page 24)

not be removed efficiently with either a spade or perhaps a specially constructed scoop. Just how far we can go in this direction has yet to be determined by practical experiments. But from the above mentioned considerations, it would, on the face of it, appear that it should be possible to apply the method to small municipal works, but probably not to the smallest works, such as are used for minor villages, hospitals, institutions, etc.

The use of channels in place of tanks is, however, not recommended for all comparatively small sewage works. For the channels to be economic in original cost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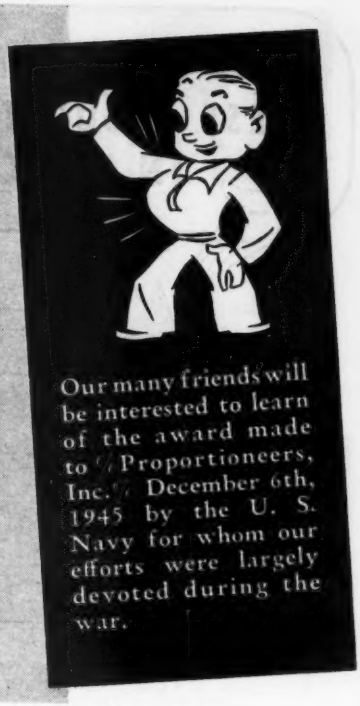
December 6 1945


Our many friends will be interested to learn of the award made to % Proportioneers, Inc. % December 6th, 1945 by the U. S. Navy for whom our efforts were largely devoted during the war.

Design and production of water purification equipment for our fighting Navy was both a duty and honor which we did our best to fulfill. The experience thus gained has now been turned to peacetime manufacture and enables us to serve you far better than we could four years ago. New models, materials and methods developed during the war — proven by the most severe operating conditions — are now ready for your use. For information on this improved water treating equipment, write to % Proportioneers, Inc. %, 96 Codding St., Providence 1, R. I.

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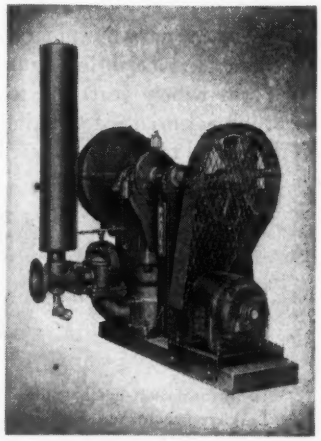

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HAVE A BROAD APPLICATION in water and sewage plant service, bringing to a central operating point from widely scattered locations, accurate records of such essential information as flow, pressure, temperature and tank or reservoir level.

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they must be at ground level, a condition which is not always practicable. If the conditions of site mean that the channels would have to be raised about the ground or sunk into the ground any great amount, they might prove costly.

While at a large sewage treatment works cleansing of channels is best effected by mechanical plant, at the small works, not only is mechanization out of question, but the simplicity of the channel designed for manual cleansing and the ease with which such channels can be cleansed are recommendations in themselves. A shallow channel with a flat bottom which is just above ground level can be dug out with remarkable ease.

In favorable conditions a very simple type of channel can be installed consisting of two channels intended to be used alternately. Each channel would have a penstock at the inlet end to control the inflow and a standing wave flume or, if free fall is available, a flat crested weir the crest of which is flush with the invert of the channel, to maintain the velocity at the constant rate desired. The channels would be approximately formed to the parabola, the simplification being such that at low rates of flow the velocity would fall below 1 ft. per second, so as to allow for grit storage. On plan, the two channels would form a long narrow rectangular chamber simple to construct. No special foundation would be required when the invert of the channels could be set to a low level compared with ground level, but should the channel have to be raised above ground level, the concrete slab forming the base could be reinforced and supported by sleeper walls at calculated intervals.

The method of operating such an installation would be as follows: Sewage would be run into one channel and permitted to flow through until the bank of detritus approached the outlet end. The penstock controlling the other channel would then be opened, and that controlling the first channel closed, on which the sewage in the first channel would run out through the flume or weir, leaving the detritus in the invert of the channel. This could be left to drain and finally dug out.

In the above description it is assumed that the size of flume or weir is permanently fixed, and that with this arrangement a satisfactory velocity is obtained at all times. It is, however, recommended that in any proposed installations of this kind some means of controlling the outlet by laterally closing penstock or adjustable plate should be provided in order that the width of the flume or weir may be varied. It would also be an advantage if the lateral moving plate could, at will, be tilted from the vertical, so as to vary the width of the outlet more or less at the top or bottom as required. Means of adjustment are always appreciated by the sewage works operator, but the main reason for this is that, while it has been generally accepted that a velocity of 1 ft. per second is suitable for the constant rate of flow of sewage in large channels, there is reason to believe that this does not hold good for small channels. Researches in other fields of inquiry have shown that scouring velocity is dependent on the hydraulic radius of the pipe or channel concerned, and that a lower velocity produces scouring conditions in a small channel than is required in one of large dimensions. After researches have been made actually with small constant velocity channels operated under test conditions, it will be possible for outlets to be designed exactly as required, but for the present the adjustable outlet is advisable.

The above is condensed from an article by L. B. Escritt in *The Surveyor*.

Sewage Gas for Motor Vehicles

DURING the gasoline shortage occasional references were seen to the use of sewage gas as a substitute. An English mechanical engineer recently said that "The experience gained at Mogden and elsewhere has been sufficiently wide and extensive to indicate that the operation of vehicle transport on compressed methane gas is perfectly sound and practicable in every way." But it will not be adopted under peacetime conditions for, said he: "It has never been anticipated that the scheme could be operated for the purpose of selling compressed gas to outside consumers in the conditions of peacetime. The disadvantage of vehicles having to obtain supplies of gas from one fixed charging point as against the general convenience and universal distribution of petrol would in itself be overwhelming in normal circumstances. The expense of transporting gas in a compressed form to other filling stations would be far too high to be practicable.

"The additional weight of cylinders to be carried by the vehicle, and the smaller range of operation as compared with petrol, are other factors against gas propulsion.

"For the successful operation of a plant of this kind, the following conditions are essential:

"(1) The plant must be working at a point near its full output . . . and a sufficient number of vehicles must be operating on compressed gas to absorb this output.

"(2) The vehicles must be stationed in close proximity to the charging point or must regularly pass the charging point on their daily journeys. Any waste vehicle mileage used in travelling to the compressor station should be charged against the scheme, and this will rule out any arrangement involving travelling more than very small distances to the point of gas supply.

"(3) The vehicles should preferably be of the heavier class where the weight of the gas cylinders is proportionately less important; they should also be engaged on local journeys where a range of travel on one charge of gas can be limited to 50 to 80 miles. This, of course, would not rule out occasional long journeys using petrol as supplementary fuel.

"(4) The vehicles should be under close control for the purpose of arranging for the charging operations to be spread over the working day at a rate not exceeding about twelve vehicles per hour; alternatively either vehicle time will be wasted or more charging panels and labor will be required for filling."

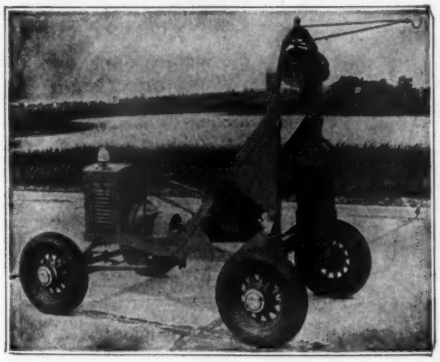
Outstanding Water Bills

Referring to the item appearing under this heading in our November issue, page 53, in which it was reported that the New Bedford, Mass., Water Department's outstanding bills over 45 days in arrears were less than 1% and asking: "Can any department show a better record?," R. C. Cope, supervisor of the Water Division of the City of St. Louis, reports:

"From December 1, 1944, to December 1, 1945, the St. Louis Water Department issued water bills in the amount of $4,443,784.54. At the close of business on November 28, 1945, the St. Louis Water Department had bills over thirty days old in the amount of $1,558.50, which would amount to .00035 of 1%. The total amount of unpaid bills regardless of the age of the bill amounted to $14,175.92 on this date, or .00319% of the bills issued for one year.

"It would seem to us that the delinquent record of

KEEP THOSE SEWERS OPEN!



Sewers clogged with sand, roots and other debris are a constant danger to public health and safety. New installations rapidly lose their efficiency due to sand seepage.

You positively can keep the sewers of your city open with an OK Champion—the cleaner that does the entire job from street level. Dig-ups practically a thing of the past.

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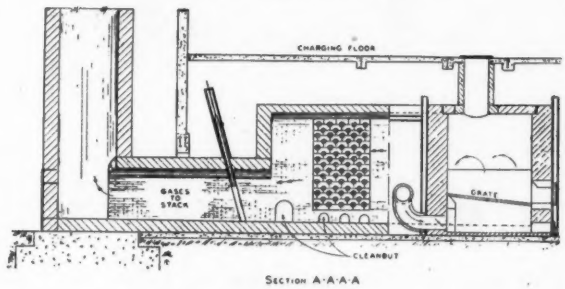

SECTION A-A-A-A

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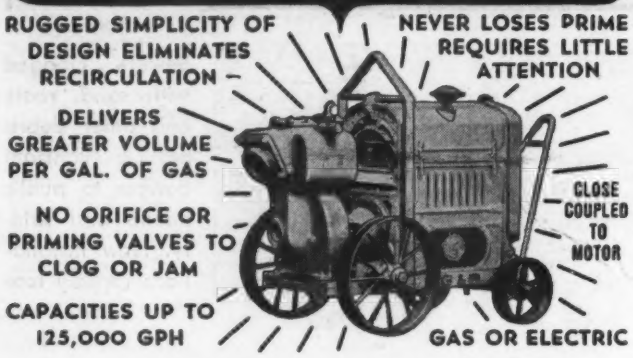
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the St. Louis Water Department would better that of New Bedford, Mass. If anyone else can show a better record on collections, we would like to know about it."

Herman Garner, superintendent of the Benton, Ill., Water Department, also writes in regard to this item, as follows:

"I have thought that I would like to know what other municipalities were doing in regard to collection of water bills. Mr. Hardy, it seems to me, has done a very good job.

"From our auditor's report at the end of our fiscal year, April 30, 1945, was that we had an income of $59,109.39; uncollectible water bills to the amount of $4.05. We had no delinquent bills.

"I would like very much that other cities would interest themselves in these articles and respond likewise."

Shallow Patching Methods Add Years to Pavement Life

Shallow patching of concrete road slabs, which varies in depth from skin patches of an inch or less to several inches, has been used extensively by the New Jersey State Highway Department wherever investigation shows that the concrete is solid below a certain depth and that the surface layer only is worn or damaged.

This method of treatment, which was described briefly in *The Highway*, official publication of the New Jersey State Highway Department and reported in Highway Abstracts, was developed some 18 years ago where a burning gasoline truck had damaged the pavement to a depth of 1½ inches. In this original operation (as well as in subsequent operations of this type) the damaged concrete was removed to insure a sound, clean surface. The perimeter of the area to be restored was hand chiseled to a vertical edge and the surface thoroughly cleaned by hand brushing with a wire brush. In this highly experimental patching of 1927, a very "rich" mix (1:1:2) was used, with four gallons of water added for each bag of cement. Immediately following the addition of 2½ per cent of calcium chloride, this "dry" concrete, which was hand mixed and allowed to approach its initial set before placement, was spread over the patch area and thoroughly tamped. It was then struck off to somewhat above the finished grade.

About fifteen minutes after the initial set, the mixture was thoroughly retamped, screeded and planed to the proper section. Curing was accomplished with damp earth and the road re-opened to traffic in 12 days. After 18 years this original patch shows no marked indication of failure.

Recently the maintenance division did some shallow patching on pavement that was originally laid in 1926, covering an area of approximately 75 sq. yd. The depth of replacement on this job varied from 1½ in. to the full depth of 8 in. The mix, in this case, was 1:1¾:3½ and the water content 4½ gal. per bag. One per cent of calcium chloride was used.

Curing in this instance was accomplished with burlap and water and unlike the original patching, curing time was reduced to 4 days, due to the traffic demands on this particular highway. Another difference between this and the job of 18 years ago was the use of machine mixed concrete.

Prior to placement of patching concrete the cleaned surface of the old concrete was thoroughly wet and dusted with cement. Particular attention was paid to

the placement of concrete immediately adjacent to the old edges in order to prevent any infiltration of surface water.

After being subjected to heavy traffic for two months, these latest patches show no failures. This is most encouraging since this job may well be classified as experimental inasmuch as it was impractical to keep traffic off the highway for a long period of curing.

Effect of Winter On Sewage Plants

DISCUSSING "Winter Difficulties at Sewage Disposal Works" in an article in *The Surveyor,* John Hurley compares activated sludge plants and percolating filters under winter conditions as follows:

In the case of activated sludge plants, winter conditions may not be so worrying, although overloading by bad tank effluent can cause complications. Troubles due to freezing and snowing up are not so likely as in the ordinary type of percolating filter, but some of the mechanical aeration devices may give trouble. For instance, the icing of the paddles in the Sheffield (or Haworth) bio-aeration system can constitute a major problem during a really severe winter. In general, it appears that activated sludge plants are most liable to give trouble during a hot dry summer, while filters need most coaxing during a cold wet winter. Where both types of plant are in use on the same works, a useful degree of flexibility can often be obtained by a seasonable redistribution of load between the two plants. The filters can, if necessary, take additional flow during the summer to relieve the activated sludge plant, while the latter can often take some extra load during the winter and early spring when the filtration plant is feeling the strain.

As an illustration of the effect of severe weather on filtration and activated sludge plants respectively, some figures for an actual plant, reasonably well designed and maintained, may be of interest. They refer to a biological filtration installation and a Sheffield type bio-aeration plant respectively. The plants work in parallel, treating the same sedimentation tank effluent, and during the period under review the distribution of load between the two plants remained fairly constant. The results given below are typical of those obtained in August and February respectively. Except for albuminoid nitrogen, figures have not been carried beyond the first place of decimals, as pretensions to more exact comparison would be unjustified in view of inevitable variations in working conditions. The results are given to convey a general idea of the effect which really severe weather had on the principal analytical results from the two types of plant:

ANALYSIS OF FINAL EFFLUENTS
Results expressed as parts per 100,000

Test	Filtration Plant		Activated Sludge	
	Summer	Winter	Summer	Winter
Chlorine in chlorides.....	12.8	12.5	13.2	11.9
Ammoniacal nitrogen	0.8	1.9	3.5	3.6
Albuminoid nitrogen	0.07	0.19	0.05	0.08
Oxidized nitrogen	3.1	2.6	—	—
4 hours oxygen absorption..	1.1	1.7	0.7	1.15
5-day B.O.D.	1.4	3.3	0.9	1.3
Suspended solids	1.7	3.6	0.2	0.8

It will be seen that, generally speaking, the filtration plant effluent deteriorated much more than did that from the bio-aeration plant, as a result of the very severe weather. It therefore appears that, under certain circumstances, the oft-repeated statement that "filters are hardier than activated sludge" may need modifying or even reversing. It is interesting to note that, as far as the filters were concerned, the adverse effects

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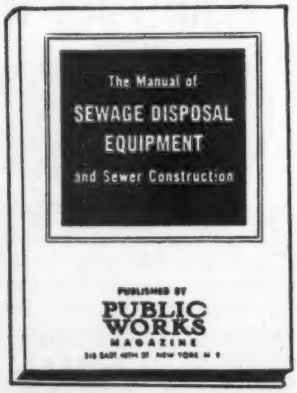


of bad weather showed much more plainly on the albuminoid nitrogen and 5 day B.O.D. figures than they did on those for 4 hours O.A. It should be noted that the figures given in the table refer to really severe conditions; the plant in question does not normally show such pronounced deterioration.

Design and Construction Procedures for Airfield Pavements

(Concluded from page 26)

concrete having strength in flexure of 700 pounds per square inch determined by beam tests after a curing period of 28 days. It has been found by correlation that the stresses, as computed by the Westergaard analysis, should be compared with the flexural strength as determined by the A.S.T.M. test for the design of concrete pavements. It is generally considered inadvisable, regardless of the nature of the subgrade, to construct concrete pavements less than 6 inches thick, as thinner slabs under traffic are too susceptible to cracking from shrinkage, temperature changes, frost heaving or other subgrade movements. As a general rule, pavement slabs employed are 7 and 8 inches thick with proper adjustment at the edges, either in the nature of thickened edges or load transfer devices to provide continuity of the slab.

Concrete airfield pavements have been constructed in longitudinal strips 20 and 25 feet wide according to the types of paving and finishing machines available for construction. In strips 15 feet wide or more, continuous longitudinal dummy joints are provided at the center of the paving strip to control longitudinal cracks that would otherwise result from warping. At intersections between runways or with taxiways and aprons, the layout and dimension of slabs are such as to carry through typical construction strips and avoid joint or edge angles less than 90 degrees as far as practicable.

Three types of joints are used in airfield paving, namely, construction, contraction and expansion. Contraction joints are both dummy and construction. These joints are used both transversely and longitudinally. The spacing of transverse dummy and expansion joints in the airfield pavements in the South have been standardized with ¾" expansion joints being placed from 75 to 125 feet apart and dummy joints from 15 to 25 feet apart in normal pavements. The edges of all types of all joints are rounded at the exposed pavement surface with a ½" edging tool, to prevent unsightly chipping or spalling. Dummy joint grooves extend one-fourth the depth of the slab and are filled with suitable filler.

The development of "controlled cracking" in pavements by using grooved or other contraction joints sealed with a filler, makes the use of reinforcing less imperative than did former practice. Since concrete for paving airfields is more or less continuously supported by the subgrade, it is not necessary or economical to design it as a reinforced concrete member with enough steel to take all the stresses due to flexure.

Curing—All concrete pavement is cured for a period of seven days by one of several approved methods. The curing medium used is applied so as to prevent the checking and cracking of the finished surface of the concrete immediately after the finishing operation is completed. The methods employed include cotton mats which are kept continuously wet for the duration of the curing period, sisal paper which is kept in place for 96 hours, or a membrane compound.

Public Works Digests

Water Supply • Sewerage • Highways and Airports

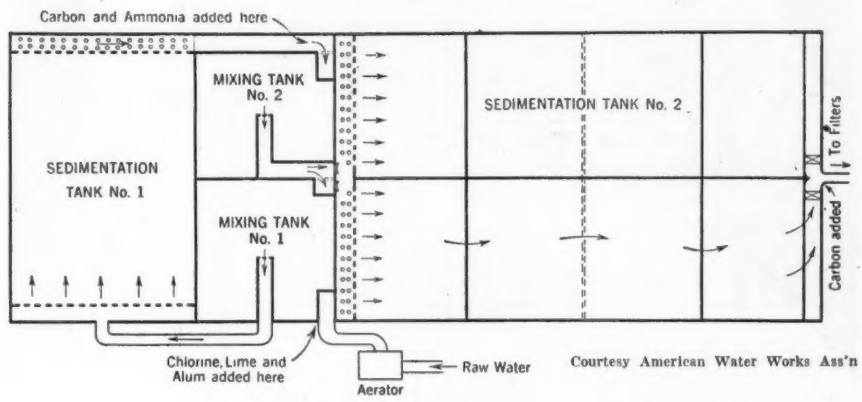
In this section are digested and briefed the important articles appearing in the periodicals that reached this office during the previous month. Appended are Bibliographies of the principal articles, in which the articles in each periodical are numbered consecutively throughout the year, beginning with our January issue.

The letter and number at the end of each digest refer to those used in the Bibliography. Numbers not found in the current Bibliography will be found in the one published the previous month.

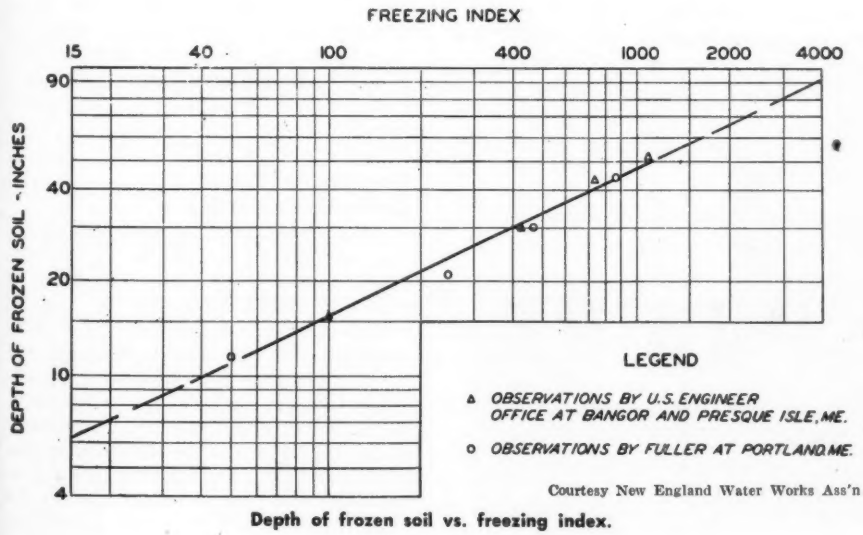
The Waterworks Digest

Depth of Mains To Prevent Freezing

It is believed that mains can be prevented from freezing if laid with the center of the pipe 6" below the maximum frost penetration. This is influenced by the magnitude and duration of air temperatures below freezing, by the thermal properties of the soil, and by the temperature conditions within the soil at the start of and during freezing. The first is measured by the "freezing index," obtained by plotting the cumulative departures of temperature from 32° F from November to April inclusive; the freezing index being the difference between the largest negative and the largest positive value. Little is known about the thermal properties of the soil, except that, in general, freezing is deepest in dry or moist sand or gravel, and that depth of frost penetration is reduced if ice segregation occurs in the soil. It is believed to be possible to correlate with reasonable accuracy the freezing index with the frost penetration. The illustration shows such a relation for moist sand and gravel based on studies by the Boston District, U. S. Engineer Dept. The freezing index for a given locality can be calculated from the Weather Bureau records. The maximum index reached 1% of the time in 100 yrs. is believed to be a reasonable basis for calculating depth to which pipe should be laid.[B4]



Flow diagram for plant of Oakmont, Pa.



Depth of frozen soil vs. freezing index.

Baffling Sedimentation Basins

At Oakmont, Pa., river water is aerated, dosed with lime, alum and chlorine, mixed 25 min. and enters primary sedimentation basin No. 1 through a distribution flume the entire width and depth of the basin, which is not baffled and is 48 ft. long by 32 ft. wide. It leaves through a perforated surface flume 2 ft. wide by 3 ft. deep and enters Mixer No. 2, is paddle-mixed and leaves by a 2 ft. x 3 ft. surface flume, and enters sedimentation basin No. 2, which is divided into two parellel basins 24 ft. wide by 80 ft. long and 20 ft. deep, with a 2-hr. detention period. In No. 2 are two underpass baffles and one overpass approximately 20 ft. apart. The effluent leaves through a surface

weir flume and flows to filters. Designed for 3 mgd, the sedimentation is efficient up to that rate, but is not for wartime rates of 3.5 to 4.0 mgd. At 3 mgd basin No. 1 removes 60% of the turbidity, and in water entering basin No. 2 the floc is dense and settles well. But at 4 mgd, No. 1 removes only 30% of the turbidity, the floc breaks down in the connecting flumes and in No. 2 there is no reduction in turbidity in the first 40 ft. and the total reduction is from 25 ppm raw water to 20 ppm in No. 2 effluent.

In discussing this, Wm. J. Murdock recommended a larger inlet pipe, distribution to the basins by multiple inlets, larger perforations in the baffle wall and effluent flume, less depth in comparison to length, larger inlet openings into basin No. 2, omission of the baffles in such a small basin, substitution of real weirs for the surface weirs. In general, velocities at weirs are too high, breaking up the floc; there are too many fluctuations in velocity; doubtful value of mixing basin No. 2.[A16]

Rehabilitating Sandstone Wells

This article refers especially to northern Illinois. Many sandstone wells were drilled too small for present demands or pumping equipment, and the cost of increasing the diameter of the bore of an old well is often greater than the cost of an entirely new well. The well may be too deep, resulting in high chloride content, high temperature, and loss of water from one stratum to another. Deposits in the pores of the sandstone may be caused by chemical actions. The most common method of removing the deposits is by "shooting" the well at the level where the water enters, which can be determined by a geophysical survey, using several 100 to 600 lb. shots. Other methods are under-reaming (which is not so effective) and acidizing (seldom if ever successful in sandstone although it may be in limestone or gravel). If salt water enters, it can be shut out by plugging off the lower part of the well. To learn of approaching need for rehabilitation, test present production, analyze water chemically, study the history of water level recession, log the well geophysically, estimate future demand. The pumping rate, pumpage, static levels, pumping levels and chemical analysis of the water should be checked at specified intervals. In one plant all wells are equipped with air lines, discharge pressure gauges, recording flow meters, and indicating ampere meters on the motors, which are read daily.[A18]

Condition of Ohio River Water

Wheeling, W. Va. has taken its water supply from the Ohio river since 1826. To produce a chlorine residual of 0.1 ppm required a feed of 1.4 lb. per mg in 1918, and 14 lb. in 1944. When a butadiene plant was put in operation in 1943, it required peak doses of 185 lb. in summer and 250 lb. per mg in winter; it is dechlorinated to below 2 ppm with sulfur dioxide, and carbon is added. Using soda ash instead of lime gives a better tasting water at any pH above 7.5 but the cost is greater. At present the river is diluted sewage loaded with organic and industrial wastes and one project is to pass it through a biological sewage treatment plant and then through a water filtering plant. Another project is to sink a well (costing about $10,000) and dilute the river water with 10% well water, increasing it to 30% by 1949. Further increase of well water would so increase the hardness that softening would be necessary.[A19]

Magnesium For Cathodic Protection

Magnesium has several properties that recommend its use as an expendable anode for cathodic protection of pipe lines. Theoretically it has an electro-chemical equivalent of 1,000 ampere-hours per pound, as compared to 372 for zinc, but the operating efficiency was found to be only about 30%. After experimenting for several years, the Dow Chemical Company has developed a magnesium alloy giving an electrical efficiency of about 50%. To maintain high efficiency and give long

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Supply lines, deferred throughout the war years, are now a "must" in many communities. They represent a long term investment for taxpayers. The pipe used should have a known record of long life and low annual maintenance cost. It should be confidently expected not only to outlive the term of the bond issue, but to serve for generations after the bonds are retired. It will if it is U. S. Super-de Lavaud Cast iron pipe, centrifugally cast in sizes up to 24 inches, or U. S. Pit Cast pipe made in sizes up to 84 inches.

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life (about 10 yrs.) corrosion must be minimized by backfilling around the buried anode with special material. For low-resistance soils the back-fill recommended is 3 parts "Aquagel" (bentonite) to 1 part ground gypsum; for high-resistance soils, use 2 parts "Aquagel," 1 part anhydrous sodium sulfate and 1 part ground gypsum. This backfill should be installed as a wet mud. The anode, 4" in diameter, is placed in a 6" hole about 10 ft. from the pipe and deep enough to bring the top of anode at least as deep as the bottom of the pipe, and the wet backfill packed around it and 4" above and 4" below it.[B1]

Chlorine Dioxide For Odor Control

Chlorine dioxide was first used commercially for the control of taste and odor in potable water supplies in 1944. It has 2½ times the oxidation capacity of chlorine. It does not produce chlorophenolic tastes and odors in water containing phenols; moreover, it will remove them if they have previously been produced by chlorination. The process developed for taste and odor control is to prechlorinate for disinfection by either simple or super chlorination, then add chlorine dioxide in the clear well to remove any taste and odors. Using this process, residuals are easily maintained. Where post-chlorination has been used because of the inability to prechlorinate due to taste problems, better disinfection and plant efficiency result from the use of chlorine dioxide. Chlorine dioxide cannot be produced in bulk and stored until wanted, but must be produced in low concentrations at the point of application and used immediately.[X2]

Checks On Operation

General averages of operating figures are given, with the idea that considerable departures from these by a given plant indicate the desirability of investigation to learn the reason. Among these averages are the following: The over-all number of employees in the operating and maintenance departments, 1 for each 800 to 1200 population up to 25,000, decreasing to 1 for each 1500 to 2000 for over 1,000,000 population. Deep well turbines of 700 gpm and over should operate at 67% to 70% wire-to-water efficiency. If this falls below 60% to 65% it will usually pay to overhaul or replace the pump bowls. Horizontal centrifugals operating against a 250 ft. head should have over-all efficiencies of 65% for a 700 gpm pump to 80% for a 7,000 gpm. If one of more than 4 mgd shows less than 70% it should be repaired or replaced or kept for stand-by service only, as for peak and fire service. Meter reading costs 5 to 7 cts. per reading on the average—some plants show as low as 3 cts. Billing and collecting should be handled by one employee for each 1,000 bills per month—some handle more than 2,000 per employee. Hydrant repairs average about $2.50 per year per hydrant — unrestricted use may account for higher cost. If meters are properly proportioned in size to the service, over 99% are 1" and under; if too large, "unaccounted-for" water generally increases. Meters are scarcely worth while unless adjusted to catch flows of 0.25 gmp or less. Average cost of repairs of meters should not exceed $1.70 per meter, with 12% of the meters repaired each year. Average cost of operation and maintenance of meters is 50 cts. per meter per year. It is usually practicable to measure and receive payment for 85% or more of the pumpage. The number of cars and trucks in cities of 100,000 to 200,000 population averages 1 for each 5,300 population, with 500 miles of travel per year per mile of main in the distribution system. Cost of distribution system operation and maintenance, exclusive of services and meters, averages about $12 per year per inch diameter per mile of pipe.[A14]

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16. Baffling Sedimentation Basins. By R. W. Hayden. Pp. 16-21.
17. Keeping Filters Clean. By Walter A. Peirce and James W. Myers, Jr. Pp. 22-30.
18. Rehabilitation of Sandstone Wells. By J. B. Millis. Pp. 31-40.
19. Present Condition of the Ohio River. By Arthur R. Todd. Pp. 41-44.
20. Main Cleaning. By Whitworth Cotten. Pp. 45-48.
21. Water Waste Surveys. By H. E. Beckwith. Pp. 49-52.
22. Detecting Illegitimate Uses of Water. By William Stava. Pp. 53-56.
23. Milestones in Taste and Odor Control. By W. A. Welch. Pp. 57-60.
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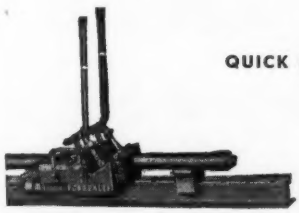

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The Highway and Airport Digest

Concreting 40 Miles of U. S. 11

In building nearly 40 miles of concrete pavement on U. S. 11 between Birmingham and New Orleans, shortage of labor and inability to obtain new equipment necessitated use of a number of ingenious devices. The pavement was 22 or 24 ft. wide except for 4-lane widenings through towns and cities and 6-lane in Tuscaloosa. On 23 miles wire mesh reinforcement was used. Dummy joints were spaced 20 ft.

On one section, concrete was batched from a central proportioning plant, using 1" max. gravel for coarse aggregate, the material being so placed in the truck and from this to the skip that the cement entered the drum ahead of the aggregates, collected while dry on the mixer blades and hardened there, and gave some trouble; this trouble probably being due partly to the use of such fine aggregate, which did not scour the drum properly.

One improvisation was use of two sheepsfoot roller drums as wheels on a farm tractor. Another was inserting longitudinal joint strips from a plank cantilevered out over the fresh concrete from a bracket fastened to the back of the finishing machine. Practically no hand labor was used in clearing and grubbing, all being done with bulldozers, tractors equipped with a side boom and winch, scrapers and other equipment.[N3]

Milwaukee's Street Inventory Record

The City of Milwaukee, in cooperation with the Public Roads Administration, has assembled from 20 original sources detailed data pertaining to construction features of existing streets and data relating to past construction and retirement experience. Ten of the sources were records in city departments, 7 were in county and state agencies, and 3 were with private contractors and real estate operators. A major problem was the selection of a method to divide the entire street system of approximately 824 miles into small usable basic units for recording this information by a comprehensive card inventory system. That selected was the "block and intersection method," in which each block and each intersection constitutes a unit. An "intersection" is that section of a street lying between property lines formed by two or more intersecting streets; a "block" in that section of a street lying between intersections. Intersections are divided into 4 groups: A—Standard, two streets crossing each other in continuous lines. B—Dead-end, two streets intersecting but only one extending beyond the intersection. C—Offset, two streets not intersecting at a common point but both extending beyond the two intersections formed. D—Multiple, three or more streets forming a common intersection; and miscellaneous. One card is used for each block; and two or more for each intersection, one for each street involved. Each railroad grade crossing bridge, viaduct, etc. is considered as a block. If a block has to be vacated or closed for some reason, a block card is made for it with explanation. Finally, the information so recorded is placed on a "Construction and Retirement Record" card, on which are entered general information, construction records, and remarks and other data. The construction record is a graphic presentation of the history of pavement construction, using a different color for each pavement type, and giving the reason for retiring or replacing a pavement. It is planned to revise the cost accounting system to give both initial and maintenance costs by block and intersection units.[E9]

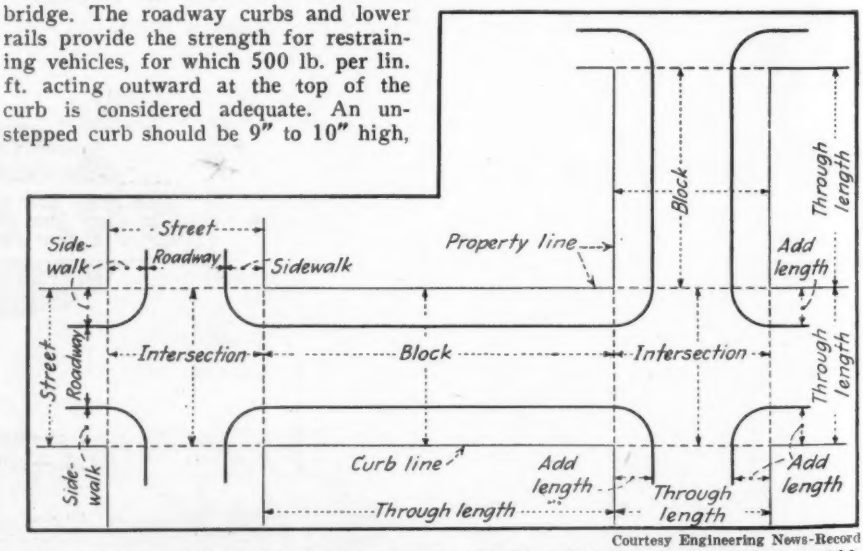
Designing Bridge Railings

Satisfactory bridge railings must be strong, sufficiently high, readily visible, provide adequate clearances and present a continuous smooth barrier to traffic. At the same time it should be attractive in appearance and cause a minimum of interference to the view from the bridge. The roadway curbs and lower rails provide the strength for restraining vehicles, for which 500 lb. per lin. ft. acting outward at the top of the curb is considered adequate. An unstepped curb should be 9" to 10" high, the inside face battered about 12 on 2; the upper curb, if used, having a setback of 4" to 6". Sidewalk railings are usually made 3 ft. high above the sidewalk surface, or 2 ft. 3 in. may suffice as a minimum if the tops are relatively wide. For safety, openings in the railing should not be more than 8" wide. The most frequent point of weakness of steel and timber rails is the connection of the post to the main structure. Many other details are included in the article.[E10]

Soil-Cement Paving Methods

Over 40,000,000 sq. yds of soil-cement pavement is in use in North America on secondary roads, shoulders for main highways, and airports. It is not suitable for heavy bombers, transport planes or airliners. Natural soil on the site is mixed with water and cement, compacted and rolled, using ordinary harrows, plows and other farm implements, sheepsfoot and steel rollers and blade graders. About 5,000 sq. yd. per 10-hr. day per gang is normal. The mixture to be used is predetermined in the laboratory, using the freeze-thaw and wet-dry tests. Organic matter resulting from decay of coniferous trees is neutralized by spraying on the soil a solution of calcium chloride.

Processing is done in lanes 25 ft. wide by about 900 ft. long. The soil is pulverized to a depth of 6" and thoroughly mixed with gang plows and harrows, making several passes and mois-



Courtesy Engineering News-Record

All streets are divided into two basic units, the "block" and the "intersection." Street width extends to the property lines, with the length of each block extending between intersections.

tening by pressure tanks. Then cement is dumped in transverse windrows and spread by chain drag and spike-tooth harrow, and mixed by a train of machines—gang plow, spring-tooth harrows, offset disc harrows and roto-tillers or pulvi-mixers, which travel up and down the lane until the color is uniform. Then about ⅔ of the needed water is applied, followed by the same train, then the remaining water and two or three passes of the train. Sheepsfoot rollers compact the bottom half of the depth, heavily loaded rubber-tired rollers the top half; blade graders shape the surface. Then it is loosened about 1″ deep by spike-tooth harrows, leveled with drags, and finished with steel-tired rollers followed by rubber-tired rollers, and kept continually damp for a week.[O10]

Snow on Airports

In handling snow on Canadian airports the R.C.A.F. has developed three methods: complete snow removal, snow compaction, and a combination of the two. They observe weather conditions and forecasts closely, are ready when the storm starts, keep all equipment in A1 condition and operate it correctly with good operators. Complete removal is most satisfactory for most snow conditions and types of aircraft, but compaction is suitable where the temperature is sufficiently low for long periods and only light aircraft are provided for. It is used on grass aerodromes. When the spring break-up occurs, the compacted snow can be scarified and removed. In the combined method, the snow is not permitted to reach a depth exceeding 9″. For compaction, the equipment used is a 50-60 h.p. tractor-drawn snow roller and snow drag. The rollers are corrugated, 3-gang, 56½″ in diameter, 10 ft. long, of galvanized sheet metal. Compacting must be begun as soon as 4″ of snow has fallen; then roll and drag daily. Should a thaw turn the compacted snow to slush, it is all removed.[O11]

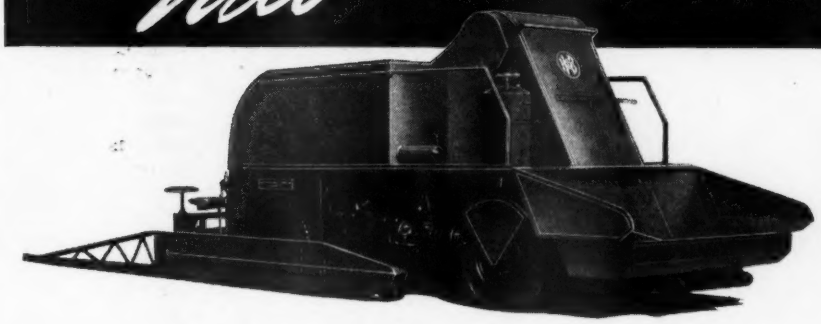
Subsealing Pavements With Asphalt

Pumping hot asphalt through holes bored in concrete pavements to seal cracks and joints from the bottom and stop pumping of subgrade material has been used successfully by the Ohio and Texas highway departments, which also find it better than mudjacking for raising depressed pavements. Since the fall of 1944 Army engineers have been using it for rigid pavements on airfield aprons and taxiways. Where the subgrade is wet, the hot asphalt disperses the free water and drives off a considerable amount of it as steam. The equipment used is an air compressor with jackhammer and 1½″ drills, an asphalt distributor with manual hose connections, flexible metal hose and nozzle, and a circulating type car heater. Generally one hole is bored for each 10 sq. yd. of pavement, and the asphalt forced in under 25 to 40 lb. pressure, until the pavement rises ¼″ or to the desired level, and the hole is then plugged. The asphalt used has a melting point of at least 185°, penetration at 32° of 15 min. and at 115° of 65 max. Cost by the U. S. Engineers' special crew has varied from 16 cts to 9 cts per gal. of asphalt placed, including cost of asphalt, drilling holes, equipment rental and labor.[O5]

Rebuilding U. S. 66 in Illinois

Illinois is rebuilding U. S. Highway 66, which runs from St. Louis to Chicago, as a "freeway," to which owners of abutting property have no right or only limited right of access. The State Highway Dept. estimates that by 1950 the peak daily traffic over this highway will reach 13,000 just outside Chicago and 7,500 outside of St. Louis. Two 24 ft. concrete pavements are separated by a median strip, towns of any appreciable size are bypassed, and the number of points of access is limited. The median strip varies from a 6″ traffic stripe to a parkway 10 to 18 ft. wide. Where possible it is a sodded or seeded depressed parkway 30 to 40 ft. wide. The subgrade is blanketed with a 6″ layer of granular material to prevent pumping. The concrete is 10″ thick,

the New MOTO-PAVER



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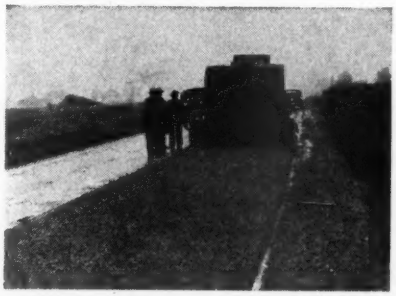
The Moto-paver handles any medium type or low cost material, and is especially suitable for resurfacing trunk roads and streets of smaller municipalities. It is also an efficient unit for new construction work on roads, streets, airports, parking lots, driveways, etc.



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with no contraction or dummy joints, but ¾" expansion joints are installed at 100 ft. intervals, across which loads are transferred by twenty-six ¾" dowels. A longitudinal plane of weakness is provided at the center line, across which they are tied together by ⅝" deformed bars 30" long. The pavement is reinforced with welded wire reinforcement 2½" below the top. All new pavement contains an integral stripe 4" wide made with black magnetic oxide of iron. The concrete is required to develop a compressive strength of 3500 psi and tensile strength of 650 psi in 14 days.[E7]

Highway Construction Outlook

Work planned by the state highway departments indicates that about $800,000,000 worth of road construction will be put under contract this year if conditions are favorable. New grading may reach 15,000 miles and new paving of all types will probably exceed 18,000 miles. Engineering, manpower, particularly in survey parties and for supervision of construction, threatens to be one of the chief bottlenecks. Contractors are available in sufficient numbers except in a few localities, and the supply of all materials except lumber appears to be adequate. Bids will probably be high, but not so much so as appeared probable early in the winter. Construction labor that wants to work is scarce, but Seabee-trained men for operating equipment will be available in considerable numbers later on. This suggests even greater use of labor-saving equipment than before the war.

As to the nature of the work, 44 states report $88,600,000 to be spent for bridges of over 20-ft. span. Two-lane concrete pavement construction is expected to reach 1,320 miles, and 4 or more-lane to reach 270 miles. Over 850 miles of bituminous concrete pavement and 4,400 miles of oiled gravel surface are anticipated, and 11,600 miles of other types of surface treatment. Secondary and feeder road construction will be notable in a number of states.[E2]

Highway Costs

Highway costs are trending upward because of scarcity of labor and higher wages, and the uncertainty of availability of construction materials. Costs at the end of 1945 were about 30% higher than in 1940. Bids on a million dollar job in Missouri were 65% to 150% above 1941 prices. In California, bids have run 30% to 40% above, in Oklahoma 20% to 35%. In several states, bids on small jobs have been higher than on large ones. In general, 20% to 30% increase in cost of general highway work over 1940 seems a fair average, and 35% to 75% for bridges and other structures.[E3]

Design Standards For Interstate Highways

In the latter part of 1945 the American Association of State Highway Officials adopted design standards for the roads to be included in the 40,000-mile National System of Interstate Highways, "the use of which is intended to produce highway facilities that represent the best practice." In general, these are based on speeds of 70 miles per hour in flat topography, 60 mph in rolling and 50 mph in mountainous topography (all in rural sections), and 50 mph in urban sections. Maximum curvatures, 4° for 70 mph to 14° for 40 mph; those sharper than 1° to be superelevated, those sharper than 2° to have transition curves. Grades preferably shall not exceed 5% and in no case 6%. Desirable sight distance for 50 mph, at least 1600 ft. for two-lane highways and 1100 ft. for three-lane, the distance for other speeds varying approximately as the square of the speed. Shoulder widths at least 10 ft. except in mountainous country, where 4 ft. is the minimum. Side slopes, not steeper than 1 on 2 for earth; 1 on 4 for fills of less than 10 ft. Lane widths for hourly traffic of less than 200, 11 ft.; for 200 to 500, 12 ft.; for 500 or greater, a divided highway is called for, with median strips of 15 to 40 ft. in rural roads and 4 ft. to 12 ft. in urban. Control of access should

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be obtained on all new locations. Grade separation should be provided at all railroad crossings of 2 or more main-line tracks, and of a single track on which there are more than 5 movements a day; and at all highway crossings with a traffic of 3,000 or more vehicles a day, and others where justified by economy, delay, hazard and convenience. Bridges should preferably be deck structures, designed for H20-S16 loadings; those up to 80 ft. length should have a clear width equal to the full pavement and effective shoulder, longer ones with clearances of at least 3½ ft. to the rails.[E4]

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BOOK REVIEW

Manual of Hot-Mix Asphaltic Concrete Paving. Published by the Asphalt Institute, 801 Second Ave., New York. 109 pages; illustrated. Sent on request.

This manual contains specifications for two types of asphaltic concrete, the so-called dense graded aggregate type and the aggregate type. Three pages are devoted to text and drawings in regard to recommended thicknesses for different type of soils, ground water tables and temperatures. The next 40 pages consider dense graded hot-mix, hot laid asphaltic concrete. These specifications cover description, materials; construction, including plant requirements and placing, jointing and compacting the mixture; methods of measurement; basis of payment; 11 pages of tests; and 11 pages of discussion on job mix formulas.

These last 11 pages are an excellently and simply prepared statement on how to design dense graded aggregate mixes. Illustrative examples are worked out to show the proper procedures.

The third part covers the design of graded aggregate hot-mix, hot-laid asphaltic concrete. The same procedure is followed as in the preceding portion of the book, and the same happy results are obtained in precision, clarity and understandability. The final portion of the book, 11 pages, covers the duties of an inspector on the work.

This is a book that every engineer and his assistant ought to have, and ought to study. It is one of the best and most practical texts we have had the pleasure of reviewing. Better send for it today.

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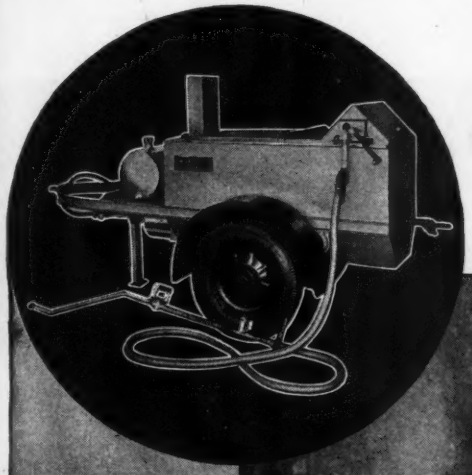
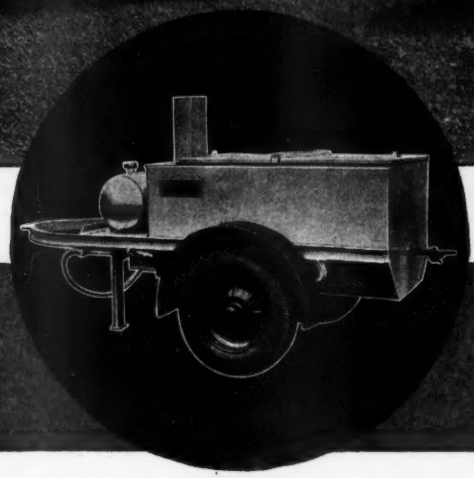
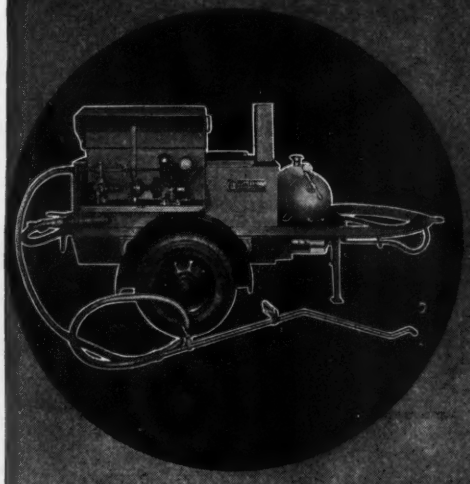


Top Circle—84-HD with Hand Spray Attachment.
Center Circle—Standard 84-HD without Spray Attachment.
Lower Circle—84-HD with Motor Spray Attachment.





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The Sewerage Digest

Madison's Sewage Gas Engines

Madison, Wisconsin, has used gas from its digestion tanks to operate two gas engines for 5 years, and calculates that during that period they have furnished power which would have cost $65,108 at the local electric rate of 1.1 ct. per kwh. The operating cost meantime was $25,807. The total investment in the engines has been $33,000.

Meantime it has been found desirable to make a number of changes in the plant. These included more durable main valve springs in the gas engines; replacing cylinder heads with others having smaller exhaust valve seats; replacing brass air valves with others made of stainless steel; replacing the heat exchanger in the circulating cooling system by an improved type; Mercoid controls of more recent model and sturdier construction were substituted for inadequate ones originally installed. The lubricating oil sludged badly, and was purified in batches by use of salsoda. Hydrogen sulfide was eliminated from the gas by installing iron sponge. Lime from the hard water accumulated in water jackets and cylinder heads, and rain water was used instead.[H1]

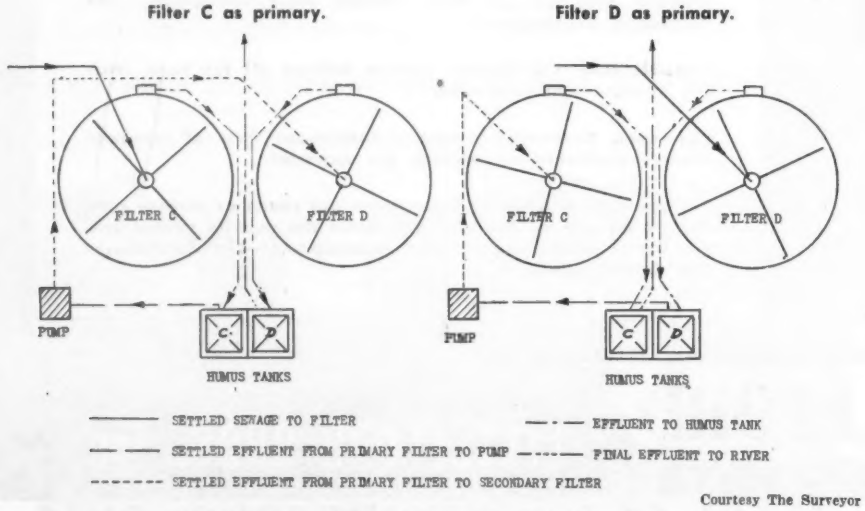
Alternating Double Filtration

In a paper before the Institute of Sewage Purification (England) E. V. Mills, of the Water Pollution Research Staff of the Dept. of Scientific and Industrial Research, described experiments with alternating double filtration at Birmingham during four years. Two filters were used, alternating as primary and secondary filters at varying intervals of from one to seven days. Meantime a third filter was operated as a single filter, using the same sewage. All three filters were of practically the same construction, except that the single filter contained 6.5 ft. of 1½" to 2" pebbles, while of the other two, one held 6.0 ft. of 1½" to 2" broken brick and pebbles, and the other 7.0 ft. of ¾" to 2" broken granite. During the first two years with weekly interchange, the B.O.D. of the settled sewage averaged 134 ppm, that of the single filter, 12.0; of the primary filter, 17.0, and of the secondary effluent, 10.5. During the second two years, with daily interchange, the settled sewage averaged 157 ppm, the single filter, 9.9; the primary filter, 22.4 and the secondary filter 11.1. During the first two years the rate of filtration, in gpd per cubic yard, averaged 77 for the single filter and 168 for the two double filters (averaging 84 gpd each). During the second two years the rate for the single filter averaged 71 and the double filter 244, an average of 1.7 times as much per filter while removing 99.2% as much B.O.D. The suspended solids in the effluents from both processes exceeded those in the influent.

The author concluded his paper as follows:

"From results of the continuous operation of the large-scale experimental plant at Minworth for four consecutive years it has been shown that settled sewage can be treated by the process of alternating double filtration at four times the rate of treatment at which similar sewage can be treated by single filtration. The highest rate of treatment tried in the alternating double filtration plant was 240 to 250 gallons per day per cubic yard of filtering medium. The effluent was of good quality and was similar to that from the single filtration plant. Although the settled sewage used in these experiments had a comparatively low biochemical oxygen demand, it was derived from a crude sewage containing toxic trade waste and it was not an easy liquid to treat. The filters were operated at steady rates of flow and were not allowed periods of resting.

"The factor limiting the rate of treatment of this particular sewage by single filtration in the plant at Minworth was the accumulation of fibrous growths on the surface of the filter. In the primary stage of the double filtration process similar fibrous growths flourished, but in the secondary stage these growths were disintegrated. Solid matter was discharged from the alternating filters fairly steadily throughout the year; at high rates of treatment fibrous growths accumulated beneath the surface of the medium in these filters, though not to such an extent as to obstruct the flow of sewage through the filters. Practically the whole of the purification was obtained in the primary stage of the double filtration process; in the winter adequate purification in the primary stage is essential to ensure continuity of the process." [D6, M7]

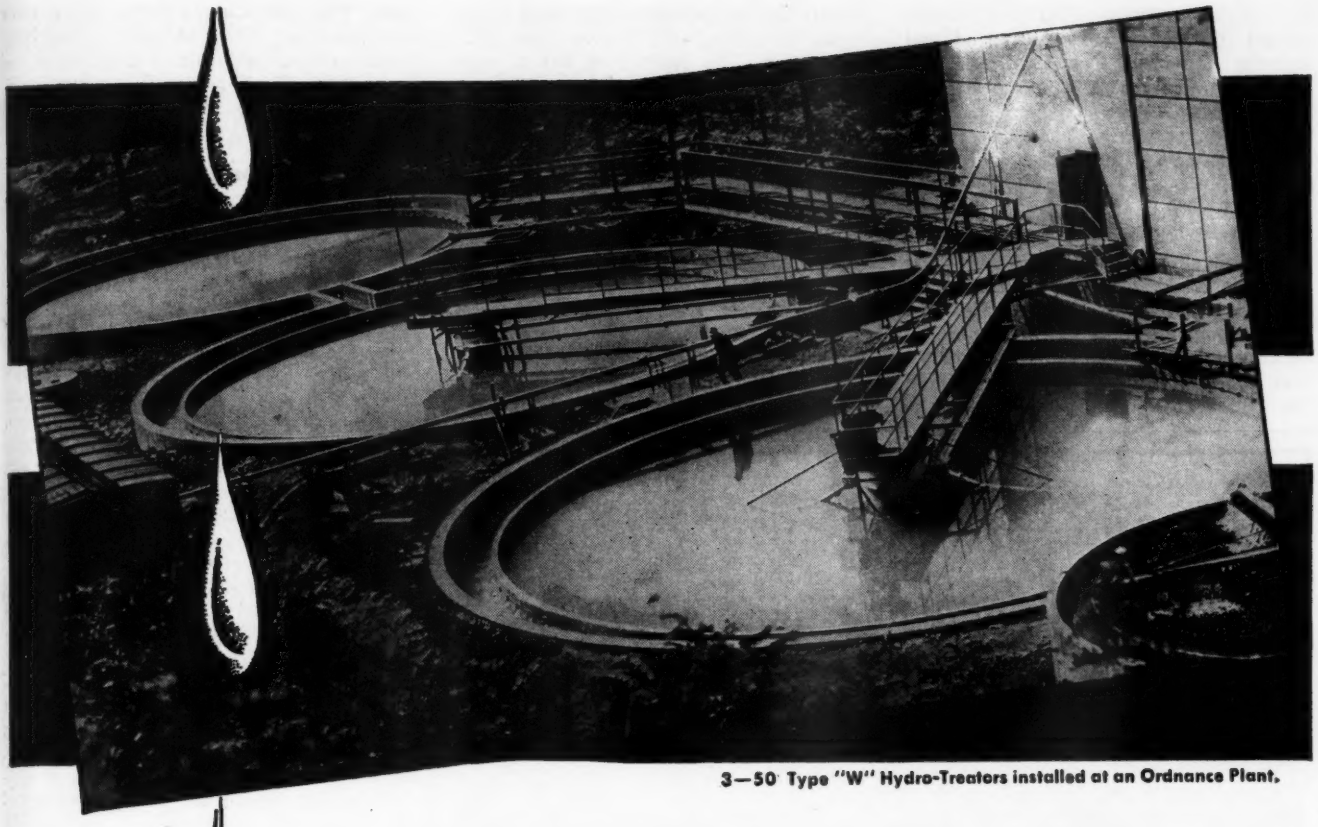


Courtesy The Surveyor

Flow diagrams of filters during tests of double filtration.

Winter Operation of Sewage Plants

Among the difficulties caused by winter weather in England are overloading of percolating filters (due to freezing or snow blocking of one of several distributors), slow drying of sludge on beds, slow digestion in unheated tanks, jumping of traction ropes from snow-blocked pulleys (on rope-hauled rectangular distributors), lack of proper lighting of outdoor units, freezing of water pipes. Most of these can be avoided by proper precautions. Slow drying of sludge can be avoided by enclosing the beds or by applying iron or aluminum salts to the sludge, or by passing liquid sludge to farm lands. If trees and shrubs are planted to beautify the site and act as a wind shield, they should not be of a type or so situated as to shed their leaves onto the filters, feed channels, dosing chambers, etc. Heating digestion tanks, practically universal in new plants in this country, apparently is not common



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in England. Preparation for winter should include snow shovels, sand and salt for clearing the walks around the tanks; powerful hand lamps, and possibly a simple box housing over each outdoor motor, such as these operating sludge collectors.[D38]

Incinerating Sludge in Detroit

Detroit, Mich., operates a treatment plant designed for 4,000,000 population at 175 gpd of sewage, and now serves about 2,200,000, which provides sedimentation and sludge incineration, and digestion of about one-eighth of the sludge. They consider digestion undesirable, and vacuum filter and incinerate the undigested sludge from sedimentation. The filter cake has a moisture content just under 70% and about 60% of the solid content is combustible. It sustains combustion without auxiliary fuel; about 0.19 gal. of fuel oil per wet ton is used in warming up the furnace when not actually incinerating. They plan a new incinerator with waste-heat recovery equipment, which will produce steam for driving a turbo-generator. The dry ash from incineration is about 14% of the total wet sludge cake and is sluiced into lagoons and allowed to dry, then removed to a dump at a cost of $1.51 per dry ton. The ash is about 50% silica, iron and alumina, 15% calcium oxide, 8% water. An experiment in using it in the manufacture of portland cement indicates possibilities in that direction.[M1 & 1]

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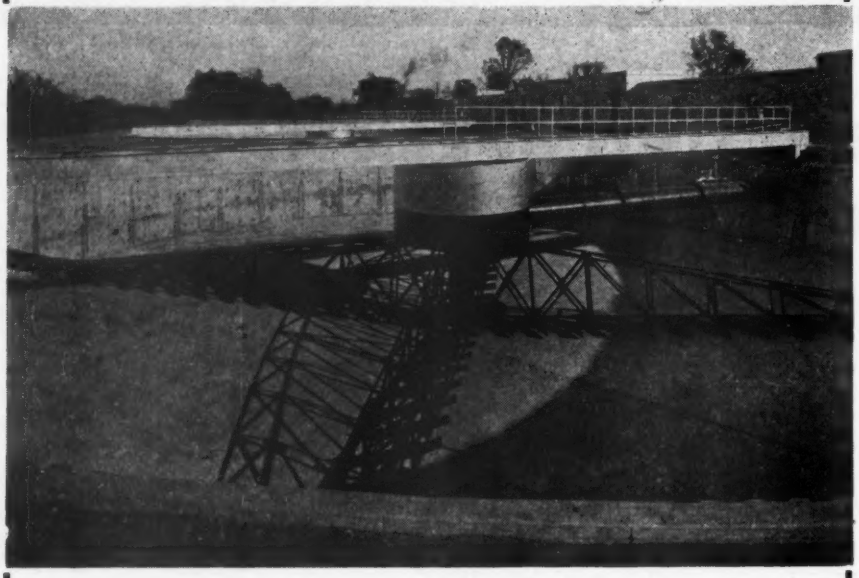

. . . in a HARDINGE CLARIFIER, for example

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A Sludge Tank Explosion

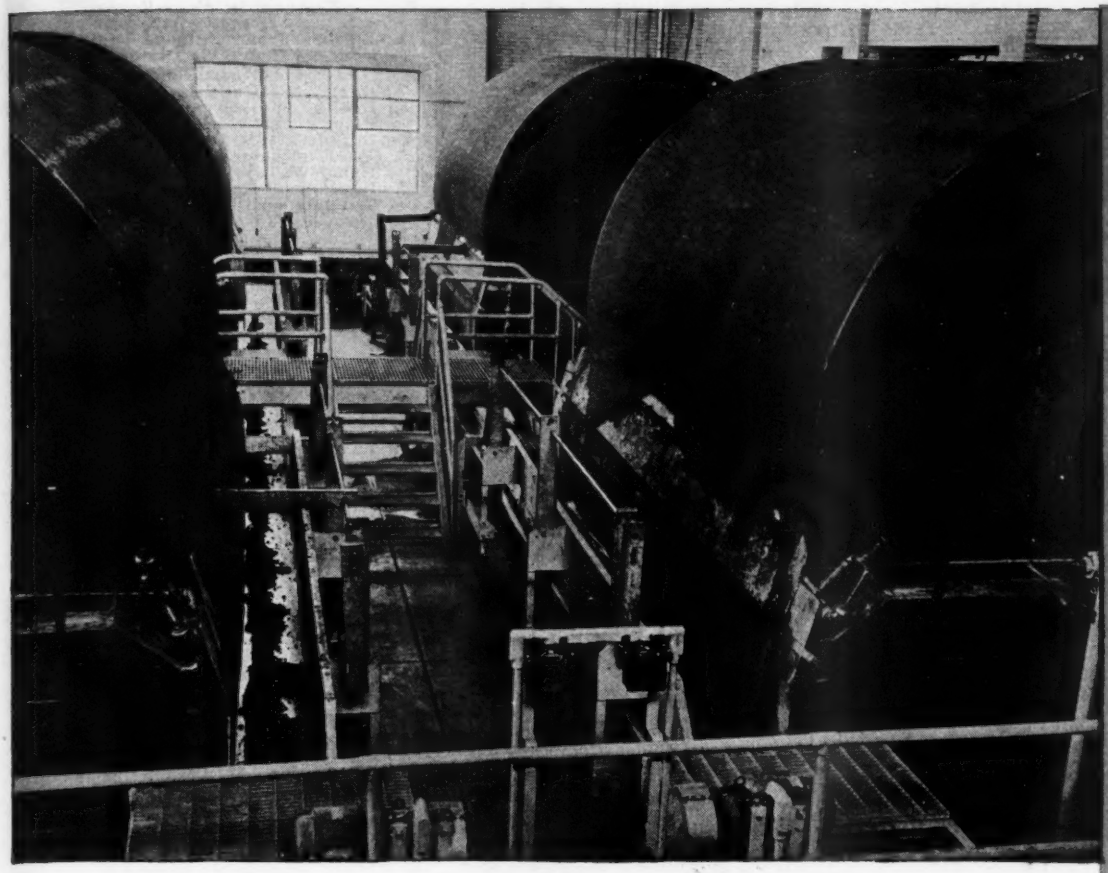
On Nov. 19, 1945, the concrete fixed cover of a primary digestion tank at Herkimer, N. Y., was blown off by an explosion of sludge gas. This was believed due to the ignition of gas by the breaking of an electric lamp which had been lowered into the tank. After nine years a mass of floating sludge had formed, and was in the process of being removed by means of a pump, the suction of which and the electric light had been lowered through the gas dome. Probably the lamp broke just as a gulp of gas broke through the floating sludge.

No one was seriously injured.

Examination showed that the heating coils suspended from the walls had fallen to the floor, possibly broken off by the weight of the floating sludge. Also a water jet nozzle used for stirring up scum had broken off and dropped into the tank. The author, who designed the tank, recommends "elimination of all equipment from a sludge tank that cannot be removed for inspection and repair without dewatering the tank. This includes everything except the sludge withdrawal pipe. Assumption of the possiblity that in years of operation a floating sludge blanket will accumulate in spite of efforts to the contrary, and provision should be made for the removal of this blanket without the necessity of drainage of the tank, complete dewatering, or entrance into it." As for heating: in view of the fact that coils become caked with sludge and coated on the inside, and can leak or break loose without detection, he suggests omitting coils and heating the raw sludge before it enters the tank. (See "Sewerage Digest," November 1945, p. 60.) [E1; H6]

Lagoon Treatment Of Camp Sewage

A Family Internment Camp was built in 1942 near Crystal City, Tex., which city received and treated its sewage, until this became too great in 1944, when the sewage was disposed of nearby by lagooning. Nine lagoons were built, each about 300 x 30 ft. and 3 ft. depth of sewage, through which the sewage flowed in series, designed for 30 days detention; the effluent flowing to a river through a mile of channel over a rocky hillside. The effluent from the plant tested about 10 ppm BOD and 28 ppm suspended solids, and at the river was 5 ppm BOD and 12 ppm solids. The raw sewage averaged 150 ppm BOD and 110 ppm solids. As the load increased still more the BOD rose to 72 ppm in Dec. 1944, and a large lagoon or settling tank 600 x 300 ft. was built to receive the effluent from the others. In March 1945 the effluent from the large lagoon averaged 21 ppm of BOD and



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Population in Wartime Washington, D. C., jumped from less than half a million to over a million. The four Conkey sludge filters in Washington's sewage treatment plant, which was designed to service a community of 650,000, demonstrated their ability to handle the consistently high overloads caused by the population jump. To do this, the filters had to be operated almost continuously on a 5-day per week schedule.

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30 ppm of solids, reduced to 11 and 16 at the river. This system is taking care of about 1800 persons. The total cost of construction has been $2,450. There is a most virulent growth of algae in the small lagoons. There is little mosquito breeding in them. The large one is stocked with larvae-eating minnows.[H7]

Hazards in Plant Repairing

In repairing corrosion of concrete tanks in the two Greenwich, Conn., plants, the contents were pumped out and the tanks thoroughly fresh-aired by blowing air into them before anyone was allowed to enter. The walls were then sand-blasted, chipped and gunited, the dust from which was removed by means of an 18" ventilating fan placed horizontally over a manhole. (Do not use electric fan until tank has been fresh-aired.) The walls were thoroughly hosed down prior to guniting, but continued to give off stagnant odors which caused slight throat irritations, so they were disinfected by spraying with a solution of a half-pint of sodium hypochlorite containing 14% available chlorine in 4 gal. of water. After an hour's work slight sneezing developed and body aches, but the worker's sinus troubles were cleared up and he felt fine three days later. In repairing the next tank, after hosing, the tank was filled with sewage dosed with chlorine until it contained 5 to 10 ppm residual chlorine, thus disinfecting the walls; after which the tank was emptied. This eliminated all the distress caused by the other treatment.[H5]

Underground Plants in Germany

At the German-built air base at Stuggart is an underground sewage treatment plant comprising settling tanks and trickling filters, located under the taxiways. The effluent combines with subsurface drainage and storm water, which flow into two lakes in which carp are raised. The ceiling over the settling tanks was lined with tile to protect the concrete from corrosive gases. A similar underground plant was found at Kassel. At Nordholz is an underground plant containing an Imhoff tank and trickling filter.[H10]

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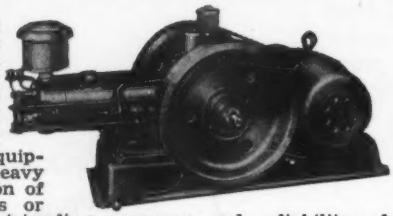

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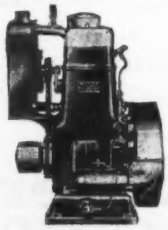

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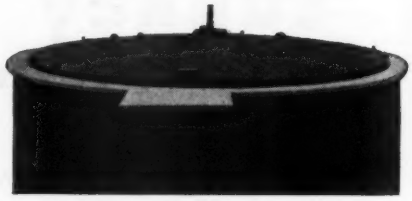

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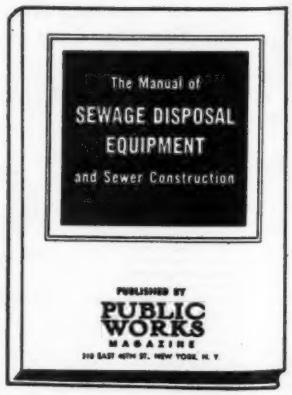

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News About People

Walter C. Conroy, general superintendent of the Belmont, Mass., Water Department, has been appointed secretary of the New England Water Works Ass'n, to fill the unexpired term of the late Frank Gifford.

Harrison D. Comins, Davenport, Ia., has been appointed assistant secretary of the American Society of Civil Engineers. He will specialize in student chapters, local sections and technical divisions, with special reference to younger engineers.

Thomas C. Keeling has been appointed general sales manager of the Tar and Chemical Division of Koppers Co. Col. Keeling served four years in the Army and was responsible for chemical production and allocation. In this capacity, he was well known to all concerned with production and control of DDT.

Jack Davies, formerly Capt. of Ordnance, U. S. Army, is now district manager for all products of the Heil Mfg. Co. in the southeastern States.

Walter R. Macatee has been appointed Manager of the Airport Division, of American Road Builders' Association and will be located at the headquarters of the Association, 1319 F. Street, Northwest, Washington 4, D. C.

Geo. M. Foster, East Lansing, Mich., has been appointed bridge engineer of the Michigan State Highway Department, succeeding the late James H. Flynn.

James C. Judge, veteran of 32 missions over Europe and an officer of the Air Corps, has joined the sales staff of Neptune Meter Co., and will cover western Oregon and western Washington, with headquarters in Portland.

John M. Dolan has been made vice-president in charge of sales for the Le Roi Co., Milwaukee, Wisc., manufacturers of engines, air compressors, gen-

John M. Dolan and Cecil W. Brown of LeRoi.

erator sets and highway-airport mowing equipment. *Cecil W. Brown* succeeds Mr. Dolan as general sales manager. *A. A. Ladvig* has been promoted to vice-president in charge of manufacturing.

Charles N. Kerr has been appointed sales promotion manager of the Tractor Division, Allis-Chalmers Mfg. Co., Milwaukee, Wisc.

William Kearn, who served in the Canadian Army, and later was employed on the Alcan Highway, has been appointed to the sales staff of Keystone Asphalt Products Co., Chicago.

Robert S. Bubb, former Lt. Commander, U. S. Navy, has been appointed sales promotion and advertising manager of Dresser Mfg. Div. of Dresser Industries, Inc., Bradford, Pa.

Norman T. Almquist has been discharged from the Seabees and has returned to the American Road Builders' Ass'n as an administrative assistant.

William E. Mikolasy has been appointed eastern sales representative of Stacey Bros. Gas Construction Co., Cincinnati, O. Mr. Mikolasy was recently released from the Army Air Forces. *Walter E. Flagg* has been appointed sales representative for New England for Stacey.

Leon C. Hulse has been made manager of the new Gar Wood Industries plant at Mattoon, Ill., which will make road machinery and heavy-duty truck bodies.

Robert S. Arthur has been appointed branch manager for Littleford Bros., Inc., with headquarters at 228 North La Salle St., Chicago.

(More on page 61)

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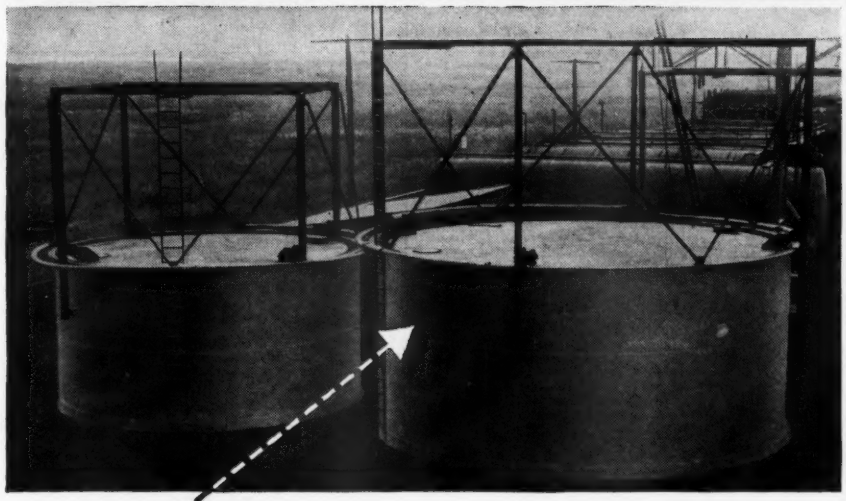

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Lt. Commander Anthony Anable, USNR, now on terminal leave, rejoined the Dorr Co. on Jan. 1 as Director of Public Relations and Advertising. Commander Anable was navigating officer of an aircraft carrier and was in four major naval actions, in the Mediterranean, Philippines, Iwo Jima and Okinawa.

Frederick G. Merckel, Harold F. Davis and *James B. Kinney* celebrated the completion, during January, of 25 years of service with Wallace & Tiernan Co., Inc., Newark, N. J. Mr. Merckel is in the main office; Mr. Davis is located in Charlotte and Mr. Kinney is in Toronto.

John Van Nostrand Dorr returned to this country on Jan. 14 following an 8-week visit to Europe.

Lt. Col. Myron W. Tatlock, formerly Superintendent of Sewage Treatment of Dayton, O., and in Europe for 21 months with Military Government Units, has become as associate of Ralph Woolpert Co., Consulting Engineers, Dayton, O., and will handle the municipal engineering phases of the work.

H. C. Maurer, a leading figure in the clay products industry, and president of the National Clay Pipe Manufacturers, Inc., died on January 16.

American Society of Civil Engineers

W. W. Horner has been elected president of the American Society of Civil Engineers for 1946. Vice-presidents elected were Arthur W. Harrington, Albany, N. Y., and J. T. L. McNew, the Agricultural and Mechanical College of Texas, both past directors of the Society. Directors are: Shortridge Hardesty, Irving V. A. Huie, Albert Haertlein, William R. Glidden, William M. Piatt, and Frederick W. Panhorst.

At a meeting held in New York, Jan. 16 to 18, the society presented awards for the past year to: Merrill Bernard, the Norman Medal for his paper, "Primary Role of Meteorology in Flood Flow Estimating"; George H. Hickox, the J. James R. Croes Medal for his paper, "Aeration of Spillways"; Donald N. Becker, the Thomas Fitch Rowland prize for his paper, "Development of the Chicago Type Bascule Bridge"; Ole Singstad, the James Laurie prize for his paper, "The Queens Midtown Tunnel"; Carl E. Kindsvater, the Collingwood prize for junior members, for his paper, "The Hydraulic Jump in Sloping Channels."

Division awards were made to: Thomas R. Camp, the J. C. Stevens award for his discussion of a paper entitled "Effect of Turbulence on Sedimentation"; L. Standish Hall, the Karl Emil Hilgard prize in hydraulics for his paper, "Open Channel Flow at High Velocities"; Langdon Pearse, the Rudolph Herring Medal in his capacity as chairman of the Society's sanitary engineering division committee on sewerage and sewage treatment.

Another award, the Construction En-

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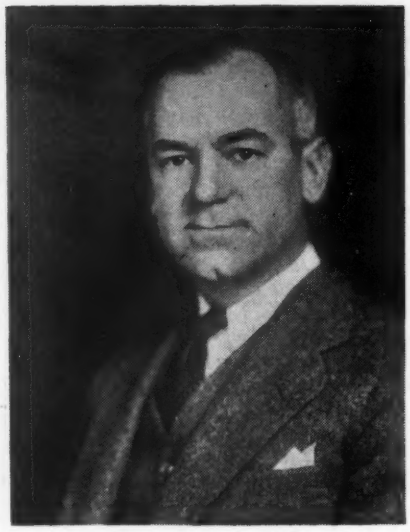
gineering prize, was presented C. Glenn Cappel, for his paper, "Timber Hangar Erected from 16-Story Scaffold." A civil engineer this year was the winner of another award, the Alfred Noble prize, given annually to a young member of one of the four founder societies of engineers or the Western Society of Engineers, August L. Ahlf, for his paper, "Design Constants for Beams with Non-Symmetrical Straight Haunches."

Lloyd Reid Heads Ice Removal Bureau

The Ice Removal Bureau, a new educational non-profit organization, sponsored by the International Salt Co., has been established at 122 East 42nd St., New York, to promote and publicize research on more efficient snow and ice removal techniques. This new organization will be headed by Lloyd B. Reid, former Traffic Engineer of Detroit and State Highway Commissioner of Michigan.

New Officers for Asphalt Institute

Geo. R. Christie was elected president of the Asphalt Institute at the December meeting. Bernard E. Gray was reelected general manager-chief engineer; Herbert Spencer, secretary and F. V. Widger, treasurer. Five regional vice-presidents were also elected: F. R. Field, Atlantic-Gulf; D. H. Jenks, Ohio-Great Lakes; Burrill Ennis, Mid-West; V. R. Black, Southwest; and W. G. Julier, Pacific Coast. Mr. Christie anticipates a very heavy demand for asphalt for both construction and maintenance.



George H. Kimber

Geo. Kimber Is Managing Director of Calcium Chloride Assn.

George H. Kimber has been appointed to the newly created position of Managing Director of the Calcium Chloride Assn. and assumed his duties on Jan. 1. He has been Manager of Calcium Chloride Sales for Solvay Sales Corp. and is thoroughly familiar with the uses of calcium chloride for road building, concrete curing and ice control.

Rockwell Manufacturing Co.

At a recent special meeting, the name of the Pittsburgh Equitable Meter Co. was changed to The Rockwell Mfg. Co. The increasing scope of the company's products prompted the change, as in addition to the Pittsburgh Equitable Meter Co., the parent company includes Merco Nordstrom Valve Co., Rockwell Machine Co., Edward Valve & Mfg. Co., Delta Mfg. Co., V. & O. Press Co., Crescent Machine Co., Rockwell International Corp., and Monessen Foundry and Machine Co. Col. Willard F. Rockwell is chairman of the board and president.

NCPMI

National Clay Pipe Manufacturers, Inc., Columbus, O., has planned a broad scale campaign to acquaint builders, contractors, architects and plumbers with the advantages of clay pipe, and to promote its use. NCPMI is composed of forty-four manufacturers of clay products. J. D. Cook, 111 West Washington St., Chicago, is secretary-treasurer.

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Construction Materials and Equipment

Air Compressors

1. LeRoi Portable compressors in sizes from 60 to 500 c.f.m., gasoline or Diesel powered on mountings to fit your special needs. Same manufacturer makes both compressor and engine. Complete bulletin. Write LeRoi Company, 1770 So. 68th St., Milwaukee 14, Wis.

2. Jaeger air compressors, made in sizes 60 to 500 cu. ft.; trailer, truck, tractor and stationary mounted, gas, Diesel and electric power. Catalog and data. The Jaeger Machine Co., 400 Dublin Av., Columbus 16, O.

Bins and Batching Plants

11. Good illustrations and useful data on all types of Heltzel Highway Bins, for truck mixer charging, bulk cement plants, enclosed bucket elevators, belt conveyors, etc. Heltzel Steel Form & Iron Co., Warren, O.

Resurfacing Plants

15. Portable Bituminous Mixers in 6 to 14 ft. sizes for resurfacing and maintenance. Issued by The Jaeger Machine Co., 400 Dublin Ave., Columbus 16, Ohio.

16. Moto-paver is a new type self-contained travelling asphalt plant having a capacity of 100 to 120 tons per hour. A novel spreading and laying device permits quick change to various road widths and crown conditions and thicknesses. Write Hetherington & Berner, 729 Kentucky Ave., Indianapolis 7, Ind. for Bulletin MP46 which gives full descriptions and specificatcns.

Concrete, Early Strength

38. 64-page manual tells how to speed concreting, to secure high early strength and greater workability at temperatures either below or above freezing. 60 photos, charts, graphs and tables. Calcium Chloride Assn., Penobscot Building, Detroit 26, Mich.

Concrete, More Durable

50. How cement dispersion assures improved concrete with impressive economies in ihitial construction costs and maintenance costs. Manual from The Master Builders Co., 7016 Euclid Ave., Cleveland 3, Ohio.

Drainage Products

70. Standard corruguated pipe, perforated pipe and MULTI-PLATE pipe and arches — for culverts, sewers, subdrains, cattlepasses and other uses. 48-page booklet, No. 12. Armco Drainage Products Association, Middletown, Ohio.

Forms, Curb and Gutter

78. Curb and Gutter and Sidewalk Forms, including battered face curb form especially for modern traffic conditions. Heltzel Steel Form & Iron Co., Warren, O., will send booklets on request.

Generators

80. Two portable generators, one for AC and the other for DC current are described in new bulletin issued by Homelite Corp., Port Chester, N. Y. Commonly used for operating electrical equipment in planes, tanks and trucks, or to charge batteries or to supplement batteries for starting main engines, etc.

Graders, Patrol

98. The Austin-Western 99M Power Grader with its powerful all wheel drive handles difficult jobs with economy and efficiency; and does better work on grading, ditching, scarifying, snow ploughing, loading, mixing, bulldozing, shoulder trenching and backsloping. Write for Bulletin 1946. Austin-Western Co., Aurora, Ill.

Joints, Expansion

102. Para-Plastic hot-poured rubber joint sealing compounds and Asphalt, Fibre, Cork, Cork-Rubber, Sponge Rubber and Waterstop expansion joints are described and illustrated. Write Servicised Products Corporation, 6051 W. 65th St., Chicago 38, for a copy.

Memorial Plaques

105. Enduring Bronze honor roll, war memorials, etc., for public places. For descriptive literature address C. H. Buck & Co., 99 Chauncey St., Boston, Mass.

106. Honor rolls, memorials, sculptured bas-reliefs, plaques, tablets, name plates and letters of bronze are illustrated and described in folder sent on request to Architectural Bronze & Aluminum Corp., 2342 W. Belmont Ave., Chicago 18, Ill.

Mud-Jack Method

107. How the Mud-Jack Method for raising concrete curb, gutter, walls and streets solves problems of that kind quickly and economically without the usual cost of time-consuming reconstruction activities—a new bulletin by Koehring Company, 3026 West Concordia Ave., Milwaukee 10, Wis.

Paving Materials, Bituminous

111. New "Tarvia Manual" is packed with useful data on how to build and maintain roads with Tarvia. Each step is illustrated with excellent action pictures, 64 pp. 103 illus. Write to The Barrett Div., 40 Rector St., New York 6, N. Y.

Piling, Steel

112. Illustrated descriptions of both standard and interlock corrugated steel sheet piling of minimum weight, maximum strength, ease of handling with methods of installation are contained in a booklet. If you have a job involving piling write Caine Steel Co., 1820 N. Central Ave., Chicago 39, Ill.

Pumps

117. New brochure by Gorman-Rupp Co., Mansfield, Ohio, illustrates and describes many of the pumps in their complete line. Covers heavy duty and standard duty self-priming centrifugals, jetting pumps, well point pumps, triplex road pumps and the lightweight pumps.

119. "Carter Self-Priming Centrifugal Pumps," a new 12-page illustrated catalog, gives detailed description of construction, and includes complete information on pump sizes, ratings and dimensions. Ask for bulletin #4310, Address: Ralph B. Carter Co., Hackensack, N. J.

Road Building and Maintenance

126. Two and Four Wheel Scrapers, Bulldozers, Tamping Rollers, Winches, Hoists and Repair Towers are subject of special bulletins issued by Gar Wood Industries, 7924 Riopelle St., Detroit 11, Mich.

128. Two powerful Galion motor graders designed to answer every requirement for more speed in road, airport, dam and housing construction work are fully described in a folder illustrated with many action pictures. Issued by Galion Iron Works & Mfg. Co., Galion, Ohio.

130. BG Maintainer, a powerful speedy, low-priced machine for light road maintenance. Write for folder, Huber Mfg. Co., Marion, Ohio.

Rollers

141. Three-Wheel and Tandem Rollers, 5 to 8-ton and 10 & 12 ton sizes: also variable weight tandem roller for new highway surfacing and old road conditioning. Huber Mfg. Co., Marion Ohio.

Soil Stabilization

150. "High-Service, Low Cost Roads" sets forth the principles and advantages of road surface stabilization with calcium chloride. Complete, interesting and well illustrated, 34 pages. Sent by Solvay Sales Corp., 40 Rector St., New York 6, N. Y.

152. Complete information dealing with Calcium Chloride Stabilized Roads. Contains many charts, tables and useful information. Write Columbia Chemical Div., Pittsburgh Plate Glass Co., Grant Bldg., Pittsburgh 19, Pa.

154. "Soil Stabilization with Tarvia" —An illustrated booklet describing the steps in the stabilization of roadway soil with Tarvia will be mailed on request by The Barrett Division, 40 Rector St., New York 6, N. Y.

Spreader

187. Mix-in Place Roadbuilders, Bituminous Pavers, Concrete Bituminous Finishers. Adjustable Spreaders, Forms, etc. —4 complete catalogs in one cover, issued by The Jaeger Machine Company, 400 Dublin Ave., Columbus 16, Ohio.

Surface Consolidation and Maintenance

188. How sub-soils can be conditioned to resist softening and frost-action; how surfacing can be consolidated to provide smooth all-weather riding surfaces; how they can be maintained so as to prevent disintegration and gravel loss. Write the Calcium Chloride Association. Penobscot Bldg., Detroit 26, Mich., for Bulletin No. 29.

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190. International Diesel Tractors are described and many uses mentioned in 48-page catalog. Write International Harvester Co., 180 North Michigan Ave., Chicago 1, Ill.

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Ice Control

354. Ice Prevention on Highways, Streets, and Airport Runways with Sterling "Auger Action" Rock Salt. An illustrated bulletin issued by International Salt Co., Inc., Scranton, Pa.

Sanitary Engineering

Air Release Valves

357. Automatic Air Release Valves for water, sewage and industrial uses are described and illustrated in new catalog issued by Simplex Valve & Meter Co., 6750 Upland St., Philadelphia 42, Pa.

Analysis of Water

360. "Methods of Analyzing Water for Municipal and Industrial Use" is an excellent 94 page booklet with many useful tables and formulas. Sent on request by Solvay Sales Corp., 40 Rector St., New York 6, N. Y.

Activation and Aeration

367. A valuable booklet on porous diffuser plates and tubes for sewage treatment plants. Covers permeability, porosity, pore size and pressure loss data, with curves. Also information on installations, with sketches and pictures, specifications, methods of cleaning and studies in permeability, 20 pp. illustrated. Sent on request to Norton Company, Worcester 6, Mass.

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386. 32-page illustrated booklet explains how a city can clean its sewers and culverts with its own forces using the up-to-date Flexible Sewer Rod equipment. Illustrates and describes all necessary equipment. Issued by Flexible Sewer Rod Equipment Co., 9059 Venice Boulevard, Los Angeles 34, Calif.

387. Literature illustrating how cities, towns and villages using OK Champion Sewer Cleaners are doing a complete sewer cleaning job from street level. Three sizes of machines available in addition to full line of sewer rods and accessories. Issued by Champion Corporation, 4752 Sheffield Avenue, Hammond, Indiana.

Corrosion Resistant Metal

391. "Everdur Metal" is title of an 8-page illustrated booklet describing advantages of this corrosion-resisting alloy for sewage treatment equipment, reservoir, and waterworks service. The American Brass Company, 25 Broadway, New York.

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423. pH and Chlorine Control. A discussion of pH control and description of comparators, chlorimeters and similar devices. An 80-page booklet, W. A. Taylor & Co., 7301 York Road, Baltimore 4, Md.

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Meters, Venturi

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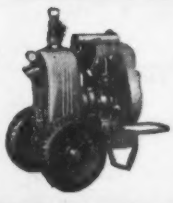
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459. For saving trucks, labor, and time in city rubbish collection get details of the new Dumpster-Kolector described in literature just published by Dempster Brothers, Inc., Knoxville 17, Tenn.

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460. Be assured of uninterrupted, constant automatic removal of screenings. Folder 1587 tells how. Gives some of the outstanding advantages of "Straightline Bar Screens" (Vertical and inclined types). Link-Belt Co., 2045 W. Hunting Park Ave., Philadelphia 40, Pa.

Sludge Drying and Incineration

463. Recuperator tubes made from Silicon Carbide and "Fireclay" Corebusters for maximum efficiency are described and illustrated in bulletin No. 11 issued by Fitch Recuperator Co., Plainfield National Bank Bldg., Plainfield, N. J.

Softening

467. Water Softening. The use of the Spaulding Precipitator to obtain maximum efficiency and economy in water softening is described in a technical booklet. Permutit Co., 330 W. 42nd St., New York 18, N. Y.

Sprinkling Filters

469. Design data on sprinkling filters of Separate Nozzle Field and Common Nozzle Field design as well as complete data on single and twin dosing tanks, and the various siphons used in them, for apportioning sewage to nozzles. Many time-saving charts and tables. Write Pacific Flush Tank Co., 4241 Ravenswood Ave., Chicago 13, Ill.

Swimming Pools

472. Data and complete information on swimming pool filters and recirculation plants; also on water filters and filtration equipment. For data, prices, plans, etc., write Roberts Filter Mfg. Co., 640 Columbia Ave., Darby, Pa.

Taste and Odor Control

474. Technical pub. No. 207 issued by Wallace & Tiernan Co., Inc., Newark 1, N. J., describes in detail taste and odor control of water with BREAK-POINT Chlorination. Sent free to any operator requesting it.

Treatment

476. Are you familiar with the new, revolutionary "Rim-Drive" Clarifier? "Rim-Drive" eliminates costly mechanism and installation, and reduces maintenance costs. Write Yeomans Brothers Company, 1425 North Dayton Street, Chicago 22, Illinois, for the complete design details, capacities and installation illustrations.

477. The Yeomans "Package" Aerifier" plant is especially designed for communities up to 3,000 population. This attractive, efficient plant, which features mechanically combined aeration and final clarification in a single tank, is described in Bulletin 6650. Write Yeomans Brothers Company, 1425 North Dayton Street, Chicago 22, Ill.

480. Booklet No. 1642 on Link-Belt Circuline Collectors contains sanitary engineering data and design details. Catalog No. 1742 on Straightline Collectors, contains layout drawings, installation pictures and capacity tables. Address Link-Belt Co., 2045 West Hunting Park Ave., Philadelphia 40, Pa.

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488. "Packaged" Sewage Treatment Plants specifically developed for small communities — 100 to 3,000 population. Write for full description and actual operating data for this type of plant. Chicago Pump Co., 2438 Wolfram St., Chicago 18, Ill.

489. Illustrated and described in detail in this bulletin, the new Carter Improved Floccer presents an entirely new method of controlled flocculation without paddle agitation. Write Ralph B. Carter Co., Hackensack, N. J.

490. New bulletin fully describes and illustrates Hardinge sludge collectors for clarifiers, sludge concentration and skimming in both circular and rectangular tanks. Write Hardinge Company, Inc., York, Pa.

Water Treatment

496. "Use of copper sulphate in water treatment plants" contains valuable data on chemicals, dosage, etc. Ferri-floc Ferric Sulphate—a new, valuable booklet on coagulation for water and sewage treatment plants. Write Tennessee Corporation, Atlanta 1, Ga.

Water Service Devices

506. Data on anti-freeze outdoor drinking fountains, hydrants, street washers, etc., will be sent promptly on request to Murdock Mfg. & Supply Co., 426 Plum St., Cincinnati 2, Ohio.

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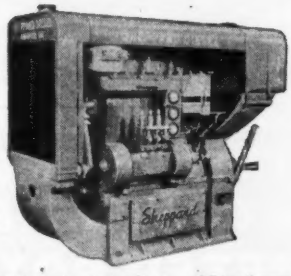
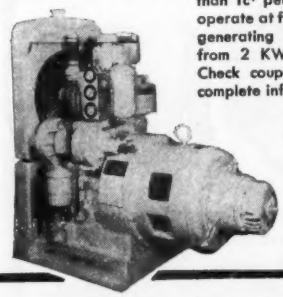


Model 6A-1 3-cylinder Sheppard Diesel power unit develops 25 continuous horsepower at 1200 R.P.M. Delivered complete...ready to run...including power take-off and clutch. Costs about 96c* to operate at full load for an 8-hour day. Other models ranging from 3¾ H.P. to 56 H.P. The coupon below will bring complete information on the power unit suited to your requirements.

Sheppard 5 KW generating set is powered by a Model 7 1-cylinder Sheppard Diesel developing 8 continuous horsepower at 1200 R.P.M. Costs less than 1c* per KW hour to operate at full load. Other generating sets ranging from 2 KW to 36 KW. Check coupon below for complete information.



*Using 8c per gal. fuel oil

R. H. SHEPPARD COMPANY, INC.
50 MIDDLE ST., HANOVER, PA.

Forward complete information on Sheppard Diesel —— Power Units ——Generating Sets.

*Name*_____

*Address*_____

_____

Power Unit H.P.—— *Generator Capacity*——

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Just see to it that the name

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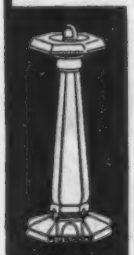


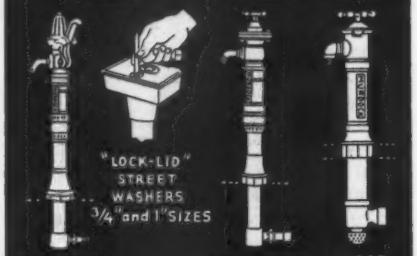
OUTDOOR DRINKING FOUNTAIN

OUTDOOR WATER SERVICE DEVICES

Give years of service. Require little attention. Low upkeep.

If you desire a copy of our latest catalog write The Murdock Mfg. & Sup. Co., 426 Plum St., Cincinnati 2, Ohio.

MURDOCK



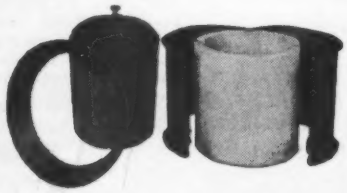
SELF-CLOSING ANTI-FREEZING HYDRANT

ANTI-FREEZING COMPRESSION HYDRANT

LARGE ANTI-FREEZING HYDRANTS 1½" TO 2" INCLUSIVE

STEEL FORMS for CONCRETE METER BOX TILES

You can make excellent meter box barrels at low cost with one of these steel forms. They are made in several sizes and lengths.



Let your post-war plans include making good use of one or more of these forms. Make a start now by asking for information.

FORD Meter Box Co.

WABASH, INDIANA

Useful Booklets and Data

R. G. Le Tourneau, Inc., Peoria, Ill.; a 4-page folder describing the *Tournatruck*, which is a trailer powered by the well-known Tournapull. Ask for Form TT-100.

Koehring Co., Milwaukee, Wisc.; an excellent booklet, well illustrated, about the Mud-Jack, with special reference to prevention of pavement slab pumping. Ask for *"How to Detect and Correct Pavement Slab Pumping."*

Stacey Bros. Gas Construction Co., Cincinnati, O.; a 50-page bulletin covering the design and construction of *telescopic wet-seal gas holders*. Valuable engineering data on welding technique, pressures, surface painting, and corrosion.

American Photocopy Equipment Co., 2849 No. Clark St., Chicago 14, Ill.; a folder describing a new *copying device* which, by a new type of design, assures that each area of the print is equally distant from the light and receives even exposure.

Jobs Available for Engineers

Those in need of personnel are invited to send in their requirements.

The Washington State Highway Department, Olympia, Wash., wants several good bridge designers; $340 to $380 per month.

Midwest water and sewage equipment manufacturer needs about 10 district sales engineers; younger men preferred. Starting salary about $300 per month. Write Col. Hardenbergh, this magazine.

UNRRA needs several sanitary engineers for duty in China; duration of work uncertain; salary about $5500 plus living expenses. Write Maj. F. A. Aldridge, UNRRA, Building F, 1344 Connecticut Ave., N. W., Washington, D. C.

Water Equipment Laboratory, Ft. Belvoir, Va., 3 or 4 sanitary engineers interested in research and development. Salary about $4300. Write C. H. Spaulding, Acting Chief.

U. S. Public Health Service, Washington, D. C., holds examinations during April and May for sanitary engineers in the regular corps, grades corresponding to 1st Lt. and Captain. Write Surgeon General, U. S. P. H. S., Washington, D. C., for data, and include brief statement of training and experience.

TECHNICAL PERSONNEL WANTED

The city of El Segundo, a sixth class city in southern California, population approximately 6500, desires to employ

(1) A graduate and licensed civil engineer as assistant city engineer, with supervisorial duties.

(2) Also a horticulturist to be employed as assistant park superintendent.

Mail applications to City Council, c/o Victor D. McCarthy, City Clerk, P. O. Box 67, El Segundo, California, and set forth qualifications, experience, salary expected, weight and height, and furnish photograph of self.

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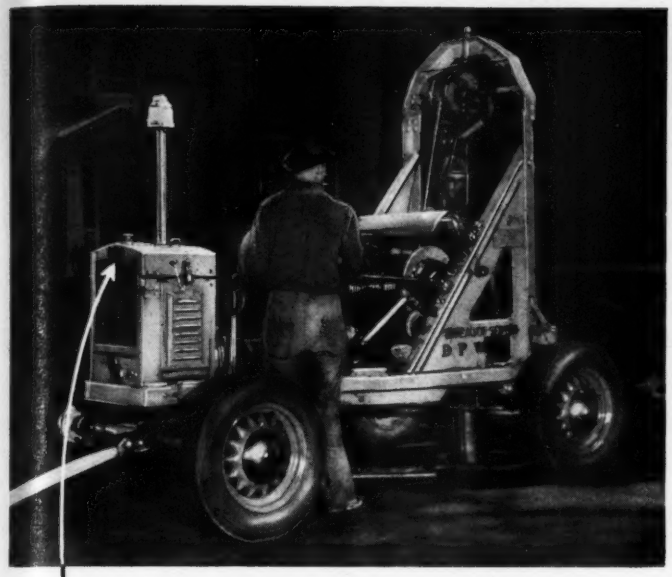

Look for the name

LE ROI

on the power unit of the equipment you buy . . .

it means dependable power

Men responsible for the operation of equipment know that Le Roi engines perform dependably and economically, and can take the punishment handed out to field equipment. The greatest reason underlying this dependability is the fact that Le Roi engines are built by a manufacturer concentrating exclusively on the problems of the heavy-duty field. These engines have the weight and stamina to stand up under all types of service.

When you specify "Le Roi" power, your recommendation is backed by more than a quarter century of experience in the specialized power requirements of your particular field.

Write for complete information.

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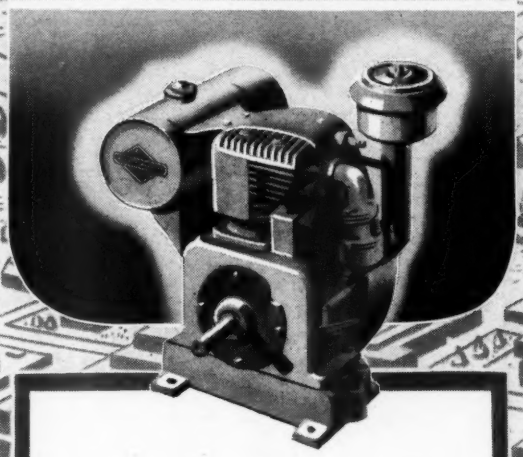
1770 S. 68th Street • Milwaukee 14, Wisconsin

ENGINES • ENGINE-GENERATORS
PORTABLE AIR COMPRESSORS

BRIGGS & STRATTON ENGINES

THE "RIGHT" POWER FOR YOUR EQUIPMENT



Manufacturers, dealers and users of gasoline powered appliances, farm machinery and industrial equipment know from experience that it pays to power with Briggs & Stratton 4-cycle, air-cooled engines.

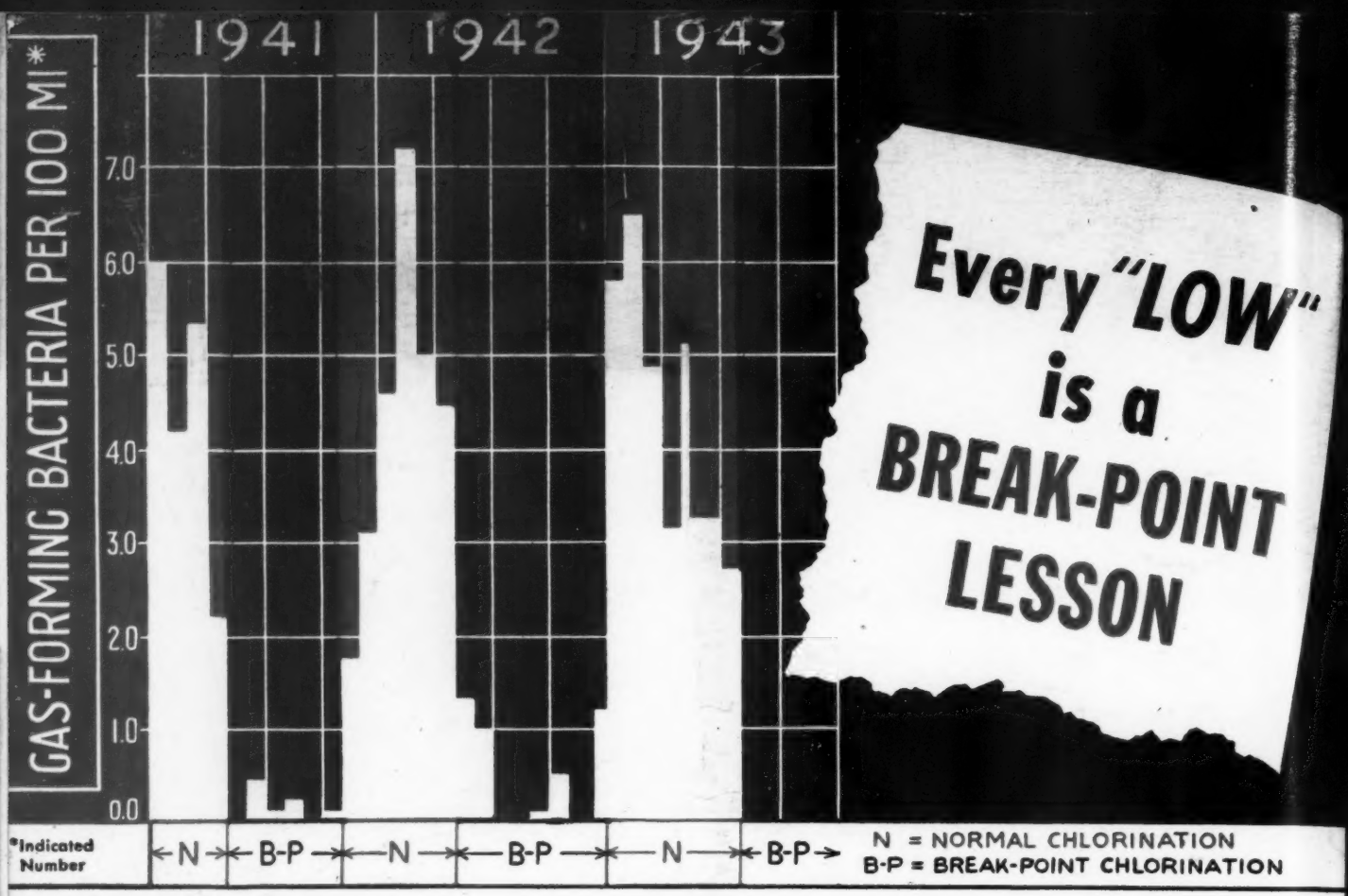
Over two and one quarter million of these engines have demonstrated their ability to deliver dependable power under all operating conditions.

Specify Briggs & Stratton engines and you are assured of the "right power" for your equipment.

BRIGGS & STRATTON CORP.
MILWAUKEE 1, WISCONSIN, U. S. A.

Air-Cooled Power

4 CYCLE
BRIGGS & STRATTON
GASOLINE ENGINES



Every "LOW" is a BREAK-POINT LESSON

SEASONAL TREATMENT shows how to bring gas-formers down

At this 4mgd municipal plant, Break-Point Chlorination was initially adopted to solve an unusually severe summer taste and odor problem. The extra margin of safety achieved was considered secondary, and during the winter Break-Point Chlorination was discontinued.

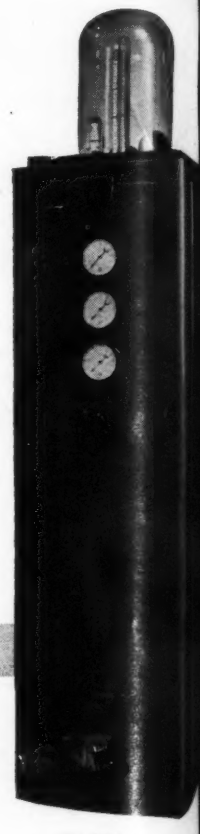
The peaks and valleys of the chart show the result – convincing proof of the effectiveness of Break-Point Chlorination in reducing *all* gas-formers.

Break-Point Chlorination–being adopted by more and more plants – substantially obviates the need for distinguishing between "confirming" and "non-confirming" organisms.

Your Wallace & Tiernan representative is ready to tell you how *free available chlorine residuals* maintained by Break-Point Chlorination can give your community a more palatable and safer water. Call him today.

BACTERIOLOGICAL DATA

	NORMAL CHLOR.	B-P CHLOR.	CHANGE
I.N. (Indicated Number) Gas-Forming Organisms per 100 ml			
Filter Effluent	4.60	0.65	–85.9%
Clear Well	4.60	0.47	–89.7%
Plant Tap	4.90	0.50	–89.7%
City Tap	4.40	0.47	–89.3%



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